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CONTENTS

NOTICES

DARTONFIELD GROUP — VISITORS' DAY

Those who wish to visit the Institute are requested to do so after making an appointment. No special days are set apart as Visitors' Days and the services of the technical officers can be availed of for discussion or demonstration only by prior appointment.

PUBLICATIONS

Rubber Research Institute publications comprising Annual Reports, Quarterly Circulars and occasional Bulletins and Advisory Circulars are available without charge to the Proprietors (resident in Ceylon), Superintendents and Local Agents of rubber estates in Ceylon over 10 acres in extent. Forms of application can be supplied to the Superintendents of large estates for the use of their assistants.

It will be appreciated if subscribers will return any back publications which are of no use to them.

ADVISORY CIRCULARS

The undernoted Circulars may be obtained on application at 30 cents per copy. Future issues in the series will be sent free of charge to estates registered for the receipt of our publications :—

No. 1 Notes on Budgrafting Procedure (Revised May, 1952).
No. 5 Straining box for latex (January,1940).
No. 6 Notes on the care of Budded Trees of Clone Tjirandji 1 with special reference to Wind Damage (September, 1938).
No. 12 Warm Air Drying House for Crepe Rubber (May, 1940) (Reprinted 1952)
No. 17 Tapping Young Budded trees — Precoagulation (2nd Supplement) (Revised March, 1949).
No. 19 Density of Planting and Thinning out (December, 1942).
No. 21 The Control of Bark Rot and Canker (Revised 1952).
No. 32 Crown Budding for Oidium Resistance (Revised October, 1954).
No. 33 Mechanical Felling of Rubber Trees (February, 1952).
No. 35 Notes on Rubber Seedling Nurseries (Superseding Circular No. 3) (February, 1952).
No. 36 Contour Lining, Holing and Filling, Cutting of Platforms, Trenches and Drains (Superseding Circular No. 4) (20th February, 1953).
No. 37 Manuring of Rubber (Superseding Circular No. 30) (March, 1953).
No. 37A Manuring — Magnesium Deficiencies (Supplement to Advisory Circular No. 37) (July, 1954).
No. 38 Planting and after care of Budded Stumps and Stumped Budgrafts (Superseding Circular No. 8) (23rd March, 1953).
No. 39 Clonal Seed as planting Material (Superseding Circular No. 26 & 27) (July, 1953).
No. 40 Tapping of Hevea Rubber (Superseding Circulars No. 17 & 34) (June, 1954).
No. 41 Pink Disease (June, 1954).
No. 42 Sale of Budwood (June, 1954).
No. 43 Oidium Leaf Disease (Superseding Circulars No. 22 & 28) (June, 1954).
No. 44 Diplodia Dieback and Collar Rot of Hevea and Blue Spot of Crepe Rubber (June, 1954).

Some Observations on the prevention of the Natural Coagulation of Ceylon Latex with Special Reference to Crepe Manufacture.

BY

E. J. Risdon (Chemist) and the Staff of the Chemical Dept.*

1. Introduction :

Since the reopening of the Chemical Dept. of the R.R.I.C. in April, 1951 there has been a gradually increasing number of written inquiries relating to the subject of the prevention of natural coagulation of latex. The R.R.I.C. has from time to time (*e.g.* 1949, 1945 and earlier) published very brief leaflets (as supplements to Advisory Circulars) relating to the subject of precoagulation and for various reasons no further work was undertaken on this subject until 1952. In 1952 (19, 20) various tests were started to compare the behaviour of certain clonal latex samples when treated with anticoagulant solutions and to ascertain information on various points of technique where Estates might go astray in commercial practice.

In February, 1953 the Sabaragamuwa District Planters' Association officially approached the R.R.I.C. concerning the prevention of precoagulation of latex from budded TJ. 1 trees in the Sabaragamuwa Province. On the assumption that the information obtained would be distributed in the district concerned, the R.R.I.C. agreed to assist in carrying out experiments designed to show whether and how the % precoagulation found in TJ. 1 latex at a 'typical' Estate in the Province could be reduced. J. W. Craig, Superintendent of Pelmadula Group, Kahawatta, offered portions of his No. 6 Division as the 'guinea-pig' area and a laboratory assistant of the Chemical Dept. (M.T.V) was stationed at the Estate (at that time a crepe producing Estate), during large parts of April and May, 1953. Prior to the experiments the % precoagulation was about 15%, this has now been substantially reduced and depending on the current market prices and the type of final product a net increase in turnover of about Rs. 6 to Rs. 12 per 100 lbs. d.r.c. from the area concerned was quite practicable.

The balance of this paper is reproduced, with only minor amendments or additions, as read before the Sabaragamuwa District Planters' Association on 26th June, 1953. A summarising abstract including parts of Table I, was included in the reprint of Paper No. 3 submitted to the Rubber Research Conference convened by the Rubber Research Board in November, 1953. The object of this paper is to summarise much of the technical and semi-technical literature relevant to the subject of the prevention of natural coagulation of latex and to describe certain experiments carried out on a commercial Estate as an illustration of the procedures which can be followed. It is hoped that perusal of this paper together with an examination of the appropriate supplements to Advisory Circulars will assist those Estates, which are having difficulty in reducing their % precoagulation to the suggested (4) maximum figure of about 2% or which have tolerated a relatively high % precoagulation.

* M. T. Veerabangsa, Laboratory Assistant.

2. The Components of Latex and the Mechanism of Coagulation

To understand the practical aspects of the prevention of natural coagulation of Hevea latex, it is not out of place to attempt to give a simplified and therefore not necessarily exact background picture of certain aspects of the development of the complex subject of latex chemistry. Thus, as long ago as 1909 (27), possibly earlier, the suggestion was made that raw rubber must be regarded as a close packing of a large number of latex particles which could be revealed by the appropriate means. At this stage latex might be regarded as a suspension of rubbery globules in a watery serum. Over the period 1923 to 1926 Whitby and others published (of 18) detailed analyses of the acetone extract or 'resins' of raw rubber showing the presence of appreciable amounts of fat and fatty acids and of their derivatives most of which may have been present in the original latex. Investigations of the distribution and significance of these substances eventually led to the discovery in 1929 by Frey-Wyssling (5) of the separate particles in which the yellow colouring matter of latex is largely concentrated. At this stage, therefore, latex might be loosely regarded as a suspension of rubbery globules, probably largely stabilised by the non-rubber serum substances, in a watery serum containing also the separate coloured Frey-Wyssling globules. In 1948 Miss Homans and van Gils identified a further set of particles (11) called by them lutoids and by Verhaar (29) viscoids. At this time Miss Homans and van Gils centrifuged substantially fresh undiluted latex and detected at least two distinct layers — an upper white fraction containing most of the rubber and a lower yellow fraction containing the lutoids, some rubber globules and the Frey-Wyssling particles mainly on top of this layer. For our purposes, therefore, latex might be loosely regarded as containing rubber globules, lutoids and Frey-Wyssling particles in the watery serum.

Again bearing in mind that this account need not necessarily be scientifically exact, immediate coagulation of latex may be said to be prevented by electrical forces arising through the individual structure of the particles or through substances present near or absorbed on the surface of the particles. On this basis complete or partial natural coagulation may be expected if the original electrical forces are seriously disrupted by suitable substances added externally or generated in situ, or by modifications of the individual components of the particles themselves. After exudation from the tree latex rapidly becomes contaminated with micro-organisms such as bacteria, which readily develop acids (6, 32 *et al*) and possibly give rise to the slime found on the surface of some latex (6). As early as 1899 (32) the action of bacteria in producing natural coagulation of latex was assumed and recent work in Malaya (16) showed that a number of latex samples exhibited spontaneous coagulation when the volatile fatty acid number of the latex attained the value .08. The action of micro-organisms producing measurable amounts of acids is not the only means by which latex will show natural coagulation. Early in this century attention was drawn (of 3, 31) to the action of enzymes in the natural coagulation of latex. Recently workers in Indonesia (11, 12) noted that whereas latex may coagulate in about 12 hours, the white fraction is stable for some days and the yellow fraction coagulates in a few hours. Since the oxidising enzyme, which produces darkening of rubber in air and which in Estate practice is largely inhabited in crepe by the action of sodium bisulphite, seems to be more active in the yellow fraction it has been suggested (12) that all enzyme activity is more pronounced in the yellow fraction, and that one possible explanation of natural coagulation might be that enzymatic breakdown leads to the accelerated formation of free fatty acids which in the presence of magnesium can effect natural coagulation. In this connection

it should be understood that van Gils had previously found (7) that certain metal soaps can coagulate fresh latex and concluded that this was due to the fact that the fatty acid ions of the soap displaced part of the protein so that the rubber particles are transformed from protein stabilised to soap stabilised particles which are not stable in liquid containing magnesium and to a lesser extent calcium ions.

More information on the relative significance of the enzyme and the micro-organism theories of the natural coagulation of latex has also come from the recent work in Malaya (by officers of B.R.P.R.A. seconded to the R.R.I. of Malaya and by officers of the R.R.I. of Malaya,) where the behaviour of sterile latex, that is latex tapped and stored in the absence of contaminating micro-organisms, has been re-examined in the light of the recent knowledge of latex components. From the information available (13, 14) it would appear that spontaneous coagulation, as it is normally encountered, is due to the action of contaminating micro-organisms, but that destabilisation of sterile latex or precoagulation of fresh latex is caused by an enzyme system set in motion by promotors liberated from the lutoids present in the so-called yellow fraction.

For purely practical purposes, therefore, the general conclusion drawn is that there are two major processes in the natural coagulation of latex, firstly enzyme destabilisation probably leading to alteration of the protein stabilising layers round the rubber particles and subsequent partial or complete coagulation of the yellow fraction that is the lutoids, Frey-Wyssling particles and associated rubber ; secondly, bacterial action leading to the production of acids and thence to destabilisation by neutralisation of the electric charge on the articles. The relative importance of these two processes depends upon the individual conditions involved. With unsuitable latices, that is latex with a high proportion of yellow fraction and of certain constituents in the yellow fraction (1), the precoagulation clot in the shell may be part or all of the yellow fraction (25). In wet weather the tendency to natural coagulation is enhanced (2, 25) by the presence of water soluble substances extracted from the bark such as tannins, which react with the protein stabilising layers round the rubber particles, and calcium or magnesium salts, which may activate the normal enzyme destabilisation process (14). Bad precoagulation at the time of wintering may also be (25) the result of changes in tree metabolism leading to differences in the proportions of the various non-rubber substances in latex.

3. Choice of Anticoagulant :

On the basis of these mechanisms the substances added to latex to prevent coagulation for the required length of time must be capable of limiting bacterial or enzymatic activity or both and/or of overcoming their effect for the time interval required. The preferred anticoagulants are usually mild alkalis (30 *et al*), *e.g.* sodium sulphite, ammonia, probably first patented as a latex stabiliser in 1853 (10) or sodium carbonate, or certain bactericides such as formaldehyde (8, 15, 17, 30) without or with the addition of an alkali (9, 17, 24, 28). Washing soda and soda ash were probably first suggested for large scale use in Ceylon in the last war due to the shortage of the more conventional anticoagulants.

From the nature of mechanisms employed to explain natural coagulation, and from the early literature (*e,g*, 4, 15, *et al*) and general experience the extent of premature coagulation may be expected to depend upon one or more of the following : (a) cleanliness of shells, spouts, buckets, etc. (b) rate and volume of the flow of latex (c) size of the task in so far that this affects

the time interval between tapping and collection (d) climatic conditions (e) distance to the collection centre and factory (f) nature of the trees constituting the task and (g) possibly soil and situation. Therefore, laying down too definite hard and fast rules of intended universal applicability in respect of the quantities of the conventional anticoagulants can be misleading, and it is unfortunate that the circulation of definite 'recommendations' or suggestions by the various Institutes may tend to imply that a considerable measure of discrimination is unnecessary. For what they are worth I have summarised some of these 'recommendations' in part of Table I, giving also a number of conversion factors to assist you to convert the various measures into other units which may be more convenient.

TABLE I

Approximate Quantities of Anticoagulant (>0%) Used as a % of the Weight of latex.

	Cups, Buckets etc.		Lorry, Collection Centre	
	'Standard' Figure	Range Encountered	'Standard' Figure	Range Encountered
Ammonia ..	·01% (23,24,26)	·01—·10%	—	·005%—·01%
Sod. Sulphite ..	·05% (23,24,26)	·05—·15%	·05% (23)	—
Formaldehyde ..	·02% (24,26)	—	—	—
Formaldehyde .. + Sod. Carbonate or (Soda Ash)	·02% + ·02% (24,26)	·02—·1% + ·02—·1%	—	—
Washing Soda ..	—	·08—·1%	—	·02%

Table I suggests that if your main product from the areas concerned is crepe sodium sulphite, possibly formalin and sodium carbonate (as washing soda and soda ash) or better washing soda alone might be suitable in so far that the incorrect use of these chemicals may not have such a detrimental effect on colour ; in other words, there may be more latitude with respect to the colour of the resulting crepe using these anticoagulants. There are however a large number of points of practical technique which are by no means clear from the table, but which are to be found again either in the literature or from general experience. Thus, while it may be possible or even essential to exceed the 'recommended' quantities, a large excess is often undesirable for various reasons including those given in the tables, and the increase in the costs of the anticoagulants, the possible increase in amounts of acids required and more important the difficulty which may be encountered in controlling the size of the first fraction in crepe manufacture.

4. Method of Application of Anticoagulants :

From theoretical grounds and previous tests it is reasonable to expect that where severe precoagulation is likely to be encountered early addition of the anticoagulant solution to the latex, *i.e.* in the tapping cups, will be advisable and in certain cases absolutely essential. In the experimental testing of anticoagulant solutions at the R.R.I.C. the area concerned may be issued with 2 cups per tree so that a dry or nearly dry cup shall be available at each tree and tapping. The procedure used requires the tapper to take the dry cup, remove the scrap from the cup and panel and then make his cut. After exudation of the latex has started a very few drops (say, 0-2, depending upon the conditions) of the anticoagulant are often allowed to

run down the cut although this may not always be essential or desirable, and the appropriate quantity of anticoagulant solution (usually 2-4 drops depending upon the conditions) is then added to the cup (frequently with gentle swirling). The whole of the anticoagulant to be employed on the experimental task or tress is not added to the cups and about 1/3 may be retained for addition to the latex in the clean collection bucket after the tapper has collected the latex from preferably at least 15 to 20 trees. Where addition to the cup is desirable or essential, the tapper should obviously be trained to portion out his anticoagulant solution with reasonable eveness between the trees, or, alternatively, since there is often a considerable variation of latex output between trees within clones the anticoagulant may be portioned out on an estimated volume of latex per tree basis. It should be noted that the R.R.I. of Malaya have suggested (26) that one half (not a third) of the anticoagulant solution should be retained for addition to the tappers' buckets. This suggestion is probably given because it is considered difficult in Malaya with contract tapping to ensure that addition to the cups is carried out satisfactorily. It will be obvious that where the work is carried out properly the larger quantity of the anticoagulant, that is 2/3 rather 1/2, should be applied early in the process *i.e.* on the cuts or in the cups. While Planters may wish to be able to avoid the possible disturbance resulting from compelling labour to distribute the anticoagulant correctly between trees, it must be stressed that where precoagulation is severe little may be gained by if, say, only 10 to 20% of the trees get anticoagulant in their cups. In my opinion failure in this respect and deliberate negligence by tappers is where much trouble may arise in commercial practice.

Various methods have been suggested (21 *et al*) to assist the tapper to portion out his anticoagulant solution. For example each tapper in the blocks or Divisions concerned may be issued with a glass bottle of suitable size which is provided with a short bamboo tube in the neck and with a rubber collar or strip of cloth which can be dipped in latex. The bamboo tube and accessories act as a stopper or cork and by cutting the end of the bamboo outside the bottle obliquely that is tapering it to a point it is possible to pour the anticoagulant in small quantities onto the places required. Alternatively, the bottle might be fitted with a slotted cork, made of soft wood.

5. Experiments on a Commercial Estate :

Where an Estate has a large area of budded rubber giving excessive precoagulation, it is generally safe to assume that early addition of the anticoagulant is desirable and that the procedures of the previous Section can be followed with advantage. Under these conditions the first requirement seems to be to decide either on a priori grounds or by small scale trials on a number of days which anticoagulant (and at what concentration) can give useful results. A summary of some of the data obtained on a modified and simplified demonstration experiment on 2 TJ. 1 tasks at Pelmadulla Group, Kahawatta is shown in Table II where certain treatments are related to approximate estimates of the % precoagulation after collection.

The figures given show certain obvious peculiarities but there are definite difficulties in estimating the yield of the tree and the % precoagulation. Nevertheless such tests should and did serve to show the Conductor in charge of the areas concerned that a substantial reduction in the % precoagulation compared to previous Estate performance under his control could be obtained by the correct use of certain chemicals. When the selection of a possible anticoagulant solution has been made either on a priori grounds or as a result of well supervised small scale tests, the scope of the trials might perhaps be

TABLE II

Date	21/4/53	23/4/53	24/4/53	22/4/53
Time Tapping Started ..	9-30 a.m.	9-30	9-30	10-00
Time of Collection ..	11-30 a.m.	11-00	10-15	12 noon
d.r.c. (AV) lbs. /gall. ..	2	4	4	3-5
Task No. ..	1	1	2	2
Treatments	% Precoagulum at 1-30 p.m.	% Precoagulum at 1-30 p.m.	% Precoagulum at 1-30 p.m.	% Precoagulum at 1-30 p.m.
1. Control (Noadditions)	20·0	25·0	25·0	23·8
2. ·02% Ammonia ..	7·5	5·7	45·0	33·0
3. ·06% Ammonia ..	4·8	3·0	2·5	2·8
4. ·12% Ammonia ..	1·3	1·5	2·0	4·7
5. ·1% Sod. Sulphite ..	3·6	—	4·3	4·7
6. ·2% Sod. Sulphite ..	3·3	·4	4·3	2·8
7. ·3% Sod. Sulphite ..	3·4	·7	2·2	4·0
8. ·04% Formaldehyde	6·0	7·0	5·0	4·7
9. ·12% Formaldehyde	5·5	6·5	6·5	4·7
10. ·04% Washing Soda	2·2	·7(?)	2·0	4·0
11. ·12% Washing Soda	1·9	·7	2·9	2·8
12. (8)+(10) together ..	5·0	7·0	8·0	7·1
13. (9)+(11) together ..	1·2	1·8	7·5	—

extended. The early data should, as far as possible, indicate whether the selected treatment will interfere with factory procedures and with the finished product. These points must be carefully watched and must eventually be considered controlling factors.

After consideration of these points and of Tables II and III, arrangements were made at Pelmadulla to carry out extended trials using .12% washing soda, decreasing the quantity at a later stage if thought desirable. Table III gives very approximate cost figures (early 1953) for various amounts of the chemicals. The quantities stated are not necessarily equivalent in effectiveness although by comparison of Table III with Table II and with other data, there is some justification for the view that washing soda is likely to be at least one of the cheaper anticoagulants. It will be noted however, that the cost of the anticoagulants is likely to be only a small fraction of the total cost of production or of the cost manufacture of crepe and it may not always be desirable to use the cheapest anticoagulant.

TABLE III

Anticoagulant	Approx. Cost./lb.	Total Quantity Used as % of Latex by Wt.	Estimated Cost of Anticoag./,1 000lbs. Latex	Local Suppliers
Ammonia ..	Rs. 1·70	·04%	Rs. 0·68	I.C.I. (Export)
Sod. Sulphite ..	,, 0·53	·10%	,, 0·53	Col. Com. Co. etc.
Formaldehyde ..	,, 3·75	·04%	,, 1·50	Scientific Suppliers
Washing Soda ..	,, 0·25	·10%	,, 0·25	Most Village Shops

The trials using .12% washing soda powder on the weight of the latex involved the use of .10% in the cups and buckets (2/3 in the cups, or on the cuts and in the cups) and .02% added at the collection centre. On the assumption that each tapper would turn in 4 gallons of latex, he would require 551 ml. of 3.3% stock washing soda solution. But since a pint is 568 ml. each tapper was issued with a pint bottle nearly full with the stock solution and instructed to proceed on the basis mentioned previously, that is to portion out his anticoagulant correctly between the trees. At the collection centre

the % precoagulation in the individual buckets was estimated very approximately and a further .02% anticoagulant added. A summary of the results is given in Table IV. While a substantial improvement in mean % precoagulation has been achieved compared to the original figure of about 15% the range in values for the individual tappers still remained large, but no doubt the range could have been substantially reduced.

TABLE IV

Date of Test	No. of Tappers Involved	Estimate of % Precoagulation for Individual Tappers.	
		Mean value	Range of value
1/5/53	2	2·7	2·3—3·0
2/5/53	8	2·4	1·5—3·6
3/5/53	13	2·3	0·0—6·3
4/5/53	51	3·8	0·0—12·5

The Superintendent at Pelmadulla Group has since carried out large scale trials using .08% washing soda and at the end of June 1953 his tentative conclusion for the area concerned was that under normal conditions .08% washing soda seems quite suitable, but that in wet whether .12% might be better. The term quite suitable should not be interpreted to mean that under the conditions employed there is no precoagulation and no difficulty in the factory, but that in Mr. Craig's present opinion the results obtained are a suitable compromise of the % precoagulation, the % fraction and of the difficulty of controlling the fractional coagulation and that the procedure is economically advantageous compared to previous Estate methods.

6. Summary

Natural coagulation of latex may take place as a result of enzymatic and bacterial activity, which may commence immediately or shortly after tapping. The conventional anticoagulants include alkalis such as ammonia, sodium sulphite and washing soda. Typical stock solutions of the chemicals may be prepared according to the directions given in Table I for each anticoagulant. It is pointed out that the suggestions given in the advisory circulars regarding the quantities of anticoagulant stock solutions required should be used with discrimination and not employed too rigidly. Various practical points concerning the use of anticoagulants in the field are discussed in detail, particular emphasis being placed upon the need to train personnel to use the chemicals correctly if the best results are to be obtained. Many of the points are illustrated by a description of experiments conducted on a large crepe producing Estate in Sabaragamuwa Province by the R.R.I.C. and by the management of the Estate concerned.

7. Acknowledgments :

Acknowledgment is made to the Proprietors and to the Colombo Agents (Messrs. J. Finlay & Co., Ltd.) of Pelmadulla Group, Kahawatta for permission to carry out the experiments described in Section 5 on rubber areas under their ownership or management. Particular acknowledgment is made to Mr. J. W. Craig, C.D.A., the resident superintendent at Pelmadulla Group, for considerable assistance in the organisation and execution of the experiments.

LITERATURE

1. Cook A. S., Mc. Mullen A. I. .. J.Rubb. Res. Inst. Malaya 1951 *13* .. (Communication No. 276) p. 135.
2. Cook A. S., Mc. Mullen A. I. .. J.Rubb. Res. Inst. Malaya 1951 *13* .. (Communication No. 276) p. 139-140.

3. Corbet A. S. .. Rubb. Res. Inst. Malaya Bull. No. 1 1929.
4. Davey W. S. .. I.R.J. 1941 *101*-19 p. 336-337.
5. Frey-Wyssling A. .. Arch. Rubbercultuur 1929 *13* p.371-412
6. Gibbons W.A., Brass P.D. .. in Davis' and Blake's Chemistry and Technology of Rubber (A.C.S. Monograph No. 74), Reinhold Publishing Corpn., 1937 p. 602-603.
7. van Gils G. E. .. Trans. I.R.I. 1947 *23*-2 p. 74-76. Rubb. Chem. Technol. 1948 *21* p. 539-541.
8. van Gils G. E. Rubber Abstracts 1952 *30*-11 No. 4631.
9. Guisenberger G. .. Rubber Abstracts 1952 *30*-11 No. 4630.
10. Hauser E. A., Kelly W. J. .. 'Latex', Chemical Catalog Company Inc., 1930, p. 100.
11. Homans L. N. S. (Miss), van Gils G. E. .. Proc. 2nd Rubb. Technol. Conf., W. Heffer & Sons Ltd., 1948 p. 292-299.
12. Homans L. N. S. (Miss), van Dulfsen J. W., van Gils G. E. .. Nature 1948 *161*-4083 p. 177-178. Rubb. Chem. Technol. 1948 *21* p. 749-751.
13. Mc Mullen A. I. .. J.Rubb. Res. Inst. Malaya 1951 *13* (Communication No. 276) p. 129-130
14. Mc Mullen A. I. .. J.Rubb. Res. Inst. Malaya 1951 *13* (Communication No. 276) p.133-134.
15. Morgan S., Stevens H. P. .. 'The preparation of Plantation Rubber Constable & Co., Ltd., 1920, p. 46 *et al.*
16. Philpott M.W.,Sekar K.C. .. J.Rubb. Res. Inst. Malaya 1953 *14* (Communication No. 281) p. 93-107.
17. Resing W. L., de Haan-Homans L. N. S. (Miss) .. Arch. Rubbercultuur 1953 Extra No. 2 p. 81-90.
18. van Rossem A. .. in Davis' and Blake's Chemistry and Technology of Rubber (A.C.S. Monograph No. 74), Reinhold Publishing Corpn., 1937 p. 17-18.
19. Rubber Research Board, Ceylon .. Circulation Paper No. 1769 p. 7-8.
20. Rubber Research Board, Ceylon .. Ann. Rept. 1953 in press.
21. Rubb. Res. Inst. Ceylon .. 2nd Supplement to Adv. Circular No. 17 1945 Edn.
22. Rubb. Res. Inst. Ceylon .. War-time addenda to 21.
23. Rubb. Res. Inst. Ceylon .. 2nd Supplement to Adv. Circular No. 17 1949 Edn.
24. Rubb. Res. Inst. Malaya .. Leaflet No. C/AL 15 (52).
25. Rubb. Res. Inst. Malaya .. Planters Bull. New Series No. 2 1952 p. 48-49.
26. Rubb. Res. Inst. Malaya .. Planter Bull. New Series No. 6 1953 p. 61-62.
27. Schidrowitz .. J. Soc. Chem. Ind. 1909 *28* 6 (From A. van Rossem in A.C.S. Monograph No. 74 p. 11).
28. Schrieke D. B. .. Arch. Rubbercultuur 1953 Extra No. 2 p. 91.
29. Verhaar G. .. I.R.W. 1952 *126*-5 p. 636-640, 644.
30. de Vries O. .. 'Estate Rubber' 1920, p. 82-91.
31. de Vries O. .. 'Estate Rubber' 1920, p. 155.
32. de Vries O. .. 'Estate Rubber' 1920, p. 159 *et al.*

NOTES ON THE USE OF THESE ANTICOAGULANTS :

1. AMMONIA : The stock solution is prepared by bubbling 1 lb. of ammonia gas carefully and slowly into 10 galls. of water. The addition of 6½ fluid ounces of this solution to 4 gall. of latex gives a latex which is approximately ·01% to ammonia (23, 26). Excess ammonia or the use of stale latex containing ammonia can affect the colour of the resulting crepe, and can adversely affect the drying rate (26). Ammonia is considered suitable for R.S.S. or cases of bad precoagulation (24, 26).

2. SODIUM SULPHITE : The stock solution is made by dissolving 1 lb. of the chemical in 3 galls. of water. The addition of ½ pint (10 fl. oz.) of this solution to every 4 gallons of latex makes the latter approximately ·05% to sodium sulphite. The stock solution should be made fresh daily (23, 26) and the chemical (powder) should be stored in a cool place in an air-tight container. Sodium sulphite may not be effective if the tendency to precoagulation is marked (30). Excess sodium sulphite is believed (26 *et al*) to retard the drying of sheet and to leave the surface tacky (or glossy) due to moisture absorption rather than to oxidation.

3. FORMALDEHYDE : Latex containing ·02% formaldehyde is made by adding 3 fluid ounces of the stock solution to every 1 gall. of latex. The stock solution is made by stirring 4 to 5 fluid ounces of commercial formalin into 1 gallon of water. Formalin readily turns acid during storage and should be made alkaline to litmus with soda ash before use (26). Very old formalin is not invariably suitable. Formaldehyde is not considered as effective in wet weather or with certain clones as ammonia and under these circumstances it may be employed with sodium carbonate or soda ash (26 *et al*). Formalin can interfere with the colour of crepe (26). The soda ash used with formalin can be employed by adding 3 fluid ounces of a 1% solution (1 lb. to 10 gall. of water) to every gall. of latex. As far as is known, formaldehyde is not employed as an anticoagulant in Ceylon.

4. WASHING SODA : The stock solution is made by dissolving 1 lb. of the powder (not crystals) in 3 gallons of water. The addition of 1 pint of this solution to every 4 gall. of latex makes the latter approximately ·10% to washing soda. This anticoagulant may be preferred by Smallholders on the grounds of cheapness but there is believed to be a risk of bubble formation (22) *e.g.* in R.S.S. As shown below it can be used for crepe, at least in certain circumstances.

CONVERSION TABLES

(a) Handbook of Physics and Chemistry 21st Edn. p. 1732-1747

60 minims	=	fl. drachm (Br.)	= 3·55 c.c.
8 fl.drachm	=	1 fl. ounce (Br.)	= 28·41 c.c.
20 fl. ounces	=	1 pint	= 568·3 c.c.
4 gills (Br.)	=	1 pint	
20 grains	=	1 scruple	= 1·2959 grams.
7000 grains	=	1 lb. (avoirdupois)	= 453·59 grams.

(b) R.R.I.M. Card 7 C (1934)

1 Table spoon	≈	½ fl. oz.
1 Desert spoon	≈	½ fl. oz.
1 Tea spoon	≈	½ fl. oz.

FIELD EXPERIMENTS

BY

D. H. CONSTABLE

There can be few planters who have not, at one time or another, wanted to test out some favourite theory in practice. Presumably comparatively few of these wishes are realised but from time to time results or layouts are sent to us and we have to reply that we are sorry that we can make no deductions from them. The originator then sets us down as incompetent and/or jealous according to taste.

The truth is, we hope, that we are neither, but that we can only offer for consideration, figures, which we believe to be accurate and the result of unbiased trials.

There is such a quantity of research to be done in relation to the staff and funds available, that we welcome any attempts to put down a useful field trial on any subject. Take soils for example, every planter knows that soil varies from estate to estate and even from field to field, so the more manurial trials that exist, the greater the probability of being able to strike a safe average for every locality, and the better the chance of being able to make individual, instead of blanket, recommendations.

Amateur trials are generally based on taking the largest possible area, splitting it in two and comparing two treatments. The logic is, that if you take two large areas side by side, then they must have the same yield and any difference after treatment is due to the treatment. On the same principle you would expect then that neighbouring estates would have even more similar yields and neighbouring districts more similar still particularly for areas of the same clone. Looked at this way most people will agree that the theory of large areas eliminating yield differences is nonsense.

What then is the answer ? The answer is that you must obtain an accurate estimate of the natural variation to be expected between similar plots, and compare your difference between treatments with this "natural" difference.

Now there are two main factors in 'natural' variation. Firstly, between trees ; every planter knows that adjoining trees of the same clone, tapper, treatment etc. can differ in yield by 200-300% at least. In seedlings the variation can be much greater. Obviously then you need a number of trees so as to strike an average and the more trees you take (I am not speaking about soil or area) the better your average will be.

But now you introduce the second main factor. When you took two trees side by side they were standing on almost the same soil and with roots intermingled, they had the same tapper, same position in the field and on the hill or valley, same amount of sun, wind, oidium, rain etc. But when you start taking in more trees they are no longer on the same or adjacent soil, nor do their roots mix. Another tapping task may be included and the difference between tappers is at least 50%. Then you may have trees on the top of the hill or on the bottom, on a spur exposed to wind or sheltered in a valley. As you expand still further, some plots may be on one side of the hill exposed to morning sun and N. E. Monsoon and others exposed to the evening sun and S. W. Monsoon.

Most planters will be well aware of the differences these aspects can make to a planting particularly when young.

Larger areas still may have different kanganies and even conductors. Then there are other factors which have passed out of the Superintendent's memory such as old line sites, (or bungalow sites), latrines, cremation places, manure sheds or dumps, and slab rock, all of which can make a large and unsuspected contribution to the growth (or otherwise) of a planting.

I have been asked " Well if I take the two areas and record the yields of each for a while then I shall know what difference to expect? ". The answer to this is best shown in the relative yearly yield figures for several exactly similar adjacent areas on Dartonfield.

The figures are :—

	PB. 86	PB. 186	HC. 28	PB. 183	TJ. 1
1951 ..	100%	79%	69%	61½%	98%
1952 ..	100%	84½%	58%	55%	92%
1953 ..	100%	79½%	75%	53½%	85½%

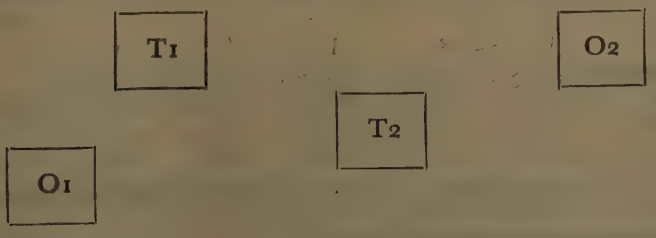
and they illustrate clearly what order of variation you may get from year to year.

As a method this is quite feasible but requires sufficient data to establish the expected yearly variation which can only be done by surveying two plots for at least five years without treatments or a larger number of plots for a shorter time. If you are to establish your point too, it is essential for one treatment to surpass the other by very much more than this expected variation.

Having outlined the drawbacks to the simple comparison what is the alternative procedure ?

Now we will consider a treatment which we compare with a Control. This treatment causes some variation in yield which we call VT and we want to know if VT is real and if so how reliable. Now we have already said that there is a natural variation between trees so we call this VN, similarly a variation between soil or position which we call VS. So, if we have two large plots one treated and one control, the difference between their yields is VT+VN+VS.

Now suppose we put out two plots of each scattered as shown.



So now we have that T1+T2 minus O1+O2 represents the total variation due to the treatment and all other factors *i.e.* VT+VN+VS.

But we also have that T1 and T2 differ only in the soil and natural factors, similarly O1 and O2 therefore T1—T2 gives a value for VN+VS as does O1—O2 and therefore from both you get an average figure. You can then compare VT+VS+VN with VS+VN in other words obtain a value for VT and see if it compares favourably with the soil and natural variation.

At this stage planters will want to know " does this work ? " and the answer is " Yes ", BUT, owing to the small number of comparisons, and the fact that you must use averages, the value VS+VN is likely to be high and it is therefore difficult to get a significant value for VT. Mathematically if the soil average variation is only 10% you will need *over* 50% variation due to your treatment when using only two plots each of treatment and control.

It is therefore preferable to have several repeats (replicates) of your treatment. It is also useful to group them as follows :—

T1	T2	O3	T4	O5
O1	O2	T3	O4	T5

or

T1	T2	O3	T4	O5	O6
O1	O2	T3	O4	T5	T6

but not

T1	T2	T3	T4
O1	O2	O3	O4

which is actually

T1
O1

This layout has the additional advantage that each block

T
O

is exactly similar to the next and therefore the difference between them is largely a soil positional one and we therefore get an estimate of VS separately and can now compare VT with VN.

Such a layout is quite simple and a total of 10-20 *plots* is quite sufficient (a plot being one area of *one* treatment or control) to give clear results if any are to be obtained.

It should be noticed that any one *block* (which contains one each of all treatments and a control) should be treated uniformly *e.g.* it should be not bigger than one tapper's task, be the same clone, tapping system, amount of Oidium dusting etc. *i.e.* its plots alike in every single detail except the one under test.

Finally as an idea of the possible variations in soil etc., the table below shows for manurial trials on estates, the %age improvement due to manure and the %age difference (largest) between similar blocks on the same area.

Estate	1	2	3	4	5	6
Manurial Difference O - NPK ..	11%	13%	28%	11%	17½%	18½%
Maximum Block Difference..	11%	52%	15%	50%	19%	22%
	Not Significant	Significant	Significant	Not Significant	Significant	Significant

Each block being at least one acre in extent.

The significance of the manurial effect could be clearly established on four out of these six results, notwithstanding the high soil variation, due to the layout allowing the segregation and evaluation of this soil difference.

In conclusion I would like to say that we are always pleased to help in the layout of a trial, and that, provided simple comparisons are wanted, such trials are not in any way impracticable for a commercial estate.

PINK DISEASE

BY

H. E. Young

This is a disease of the branches and stems of Hevea rubber trees caused by the fungus *Corticium salmonicolor* B. et Br. It is spread throughout the warmer regions of the world and is a parasite on a large number of cultivated and wild plants. The disease has among other plants been found, on rubber, tea, coffee, cocoa, cinchona, citrus, jak, mango, pueraria, tephrosia, ramie etc.

Symptoms.

The most outstanding symptom of this disease is the appearance on the bark of the affected tree of a salmon pink superficial incrustation, with a white border, from which the disease obtains its name. This pink appearance however is not always present and depends on the stage of development of the fungus.

Other signs are :—

1. Wilting and death of the leaves of a branch or branches. The leaves do not fall off, but dry out and remain attached to the branch for some time.

2. Black streaks of coagulated latex caused by bleeding of branches and stems.

3. Development of new lateral shoots on branches or trunks due to the development of dormant buds.

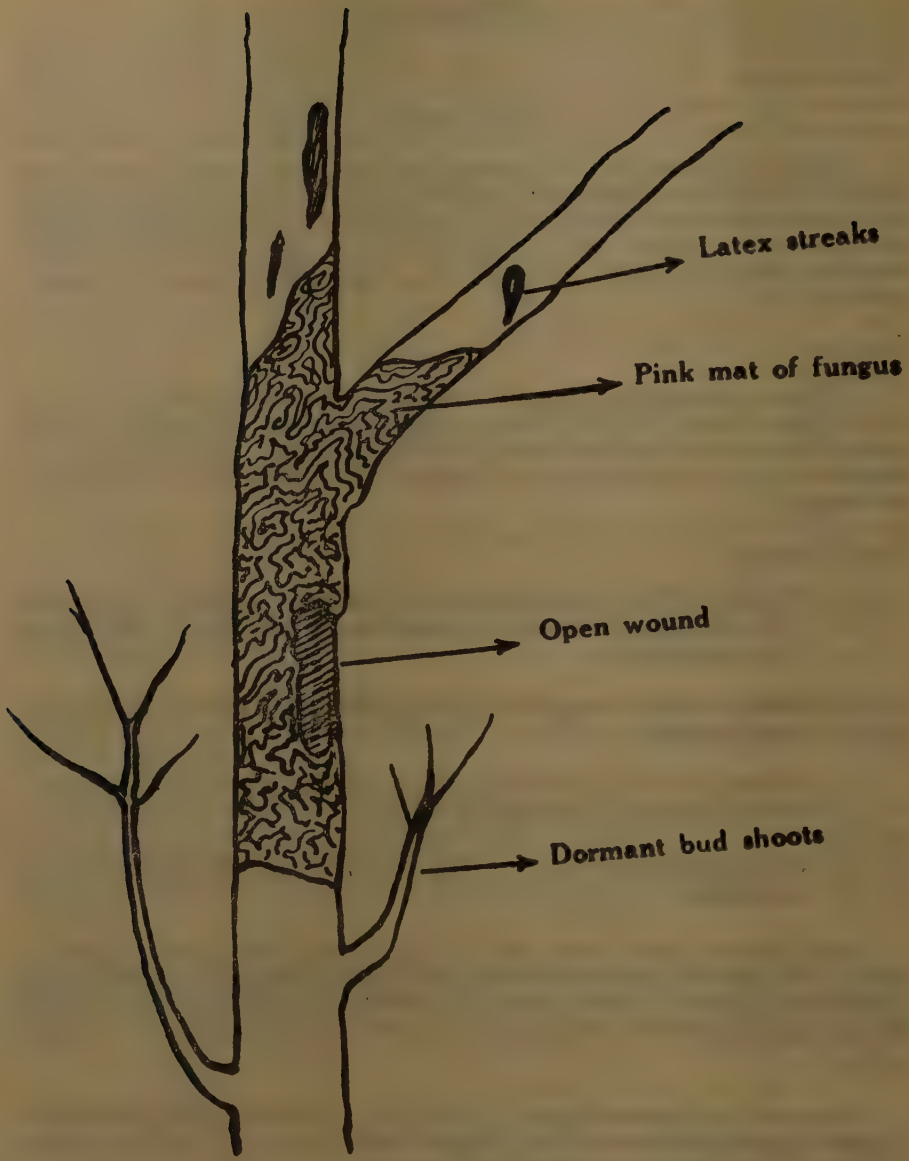
4. The appearance of open wounds (cankers) due to the death of patches of bark.

Pink disease appears most often at the forks of branches and twigs as well as on unforked wood and usually on the lower side which is less subject to the sun's action. It also occurs in cracks in the bark where water collects and on parts shaded by dense foliage. It generally occurs during the rainy season.

The pink incrustation appears at the time the fungus causing the disease is ready to produce spores. In old cases these pink areas become yellow and later whitish yellow, especially in dry weather.

The fungus threads, from their beginning on the surface of the bark from the original spores, rapidly penetrate the bark tissues causing their death. The bark, underneath the fungus incrustation on the surface, becomes black and develops deep cracks and readily peels off the wood which itself is penetrated by the fungus threads and the area affected dies. This affected area may extend right round the branch, especially when this is a small one, and cause the death of the distal part.

Sometimes the incrustation only appears as a thin whitish mat composed of fungus threads on the surface of the bark and which are not usually noticeable.



Pink Disease (Corticium salmonicolor B. et. Br.)
showing several major symptoms.

The imperfect on conidial stage of the fungus, in contrast to the perfect basidial stage, described above is inconspicuous and is known as *Necator decretus* Massee. This stage is marked by little concretions of pustules on the surface of the bark. These are at first whitish and later become orange red and are more or less circular and about $\frac{1}{2}$ — $1\frac{1}{2}$ millimetres in diameter. This form is found mainly on the most exposed parts of the bark on the upper surface of the branches and twigs and on the most exposed parts of the trunk. This form preceeds the formation of the characteristic pink incrustation of the perfect form.

FRUITING BODIES.—

Conidial or imperfect stage : The pustules are formed of globular masses of fungus threads at first in the surface of the bark but which later burst out of the surface. The pustules produce microscopic oval shaped colourless spores which are discharged from the pustules.

Perfect stage : The corticium stage appears as a flat thin incrustation with a warty appearance. On the surface of the mat are produced the spores (basidiospores) which are microscopic, pear shaped or globular, pointed, and colourless.

METHOD OF DISSEMINATION OF THE DISEASE.—

The fungus is propagated by the basidiospores which are developed on the perfect corticium form and which when detached from the fungus are carried great distances by the wind and which germinate and cause the disease when coming to rest on a suitable host under suitable conditions. Spread of the disease takes place principally in wet weather when the fungus is sporing freely.

DAMAGE CAUSED BY THE DISEASE.—

The injury caused by the fungus is variable depending on the intensity of the attack and the age of the rubber trees. It is very dangerous on young trees of 2—4 years of age because the fungus by penetrating the conducting tissues and also destroying the bark of the relatively small branches or stems can cause their death as evidenced by the wilting of the leaves. On manure trees, attack on the trunk and large branches is in general less serious, but however weakens the trees and the penetration of the fungal threads (hyphae) into the conductive tissues of the trees often causes a decreased production of latex.

METHODS OF CONTROL.—

The methods of control are both preventive and curative but on the whole it is very difficult to completely free a plantation from this disease.

Preventive measures consist in avoiding producing very dense plantations by having frequent roads and paths to facilitate air circulation. The planting of shade trees should be avoided. Planting of intermediate or under crops of a shrubby nature should be avoided in wet areas as these often create by their shade and interruption of free air flow a climate very suitable for the development of the disease. Shrubby undergrowth should, for the same reason not to be allowed to develop.

The ground should be kept free of fallen branches as these are a base for saprophytic growth of corticium and a breeding place for its spores.

Curative measures. It is essential to remove and destroy by burning all diseased and dead branches.

All small branches which are infected with Corticium should be cut off about one foot below the diseased patch in order to remove the fungus which spreads in the bark from the diseased patch. These branches should also be burned.

When trunks and large branches are attacked and not ringbarked the diseased area should be carefully cut out. The scars thus made should be painted with coal tar and the excised material burned.

In the early stages of attack, Pink Disease on young trees may be checked by spraying or painting the infected bark with bordeaux mixture or other copper fungicide or tar acid fungicides the latter however cannot be used as a spray as they may damage the foliage.

Where the disease has advanced to the stage where leaf wilting occurs spraying is useless as the fungus has now entered the tissues and surgery must be resorted to.

Before pruning or excision is carried out however it is very essential to paint the affected bark with an asphalt kerosene mixture (Asphalt 40 lb. Kerosene or Diesoline 4 gals. Solignam 3 pints) or coal tar. *This precaution should never be omitted.* Its object is to prevent the spores of the fungus and infected bits of bark and wood being shaken loose or knocked off and distributed by the pruning operation.

All such pruning should preferably be confined to fine weather as the disease is more highly infectious in wet weather. If this rule is observed it should be clearly understood that pruning only is delayed. The protective coating of the tar etc. should be applied as soon as the disease is discovered.

When pruning is carried out the diseased material (previously coated with a protective paint) should be burned.

When a serious outbreak occurs in a young stand it is advisable to spray all the stems of the young trees with bordeaux mixture or other copper fungicide at three-weekly intervals until the disease has cleared up. This is an additional protective measure.

Where the disease occurs in mature trees in tapping the use of copper fungicides such as bordeaux mixture must be avoided owing to the bad effect of copper when introduced to latex.

If the attack is recent and there appears to be a chance of saving the affected branch *i.e.* if no wilting of the leaves has occurred and ringbarking is not apparent the patch should be painted with a mixture such as the Brunolinum Plantarium 10% — Socony Vacuum product 2295 1A as is used for tapping panel diseases. If however the disease is advanced the branch must be pruned off as described above, after the patch has been painted with tar, and later burned.

OIDIUM LEAF DISEASE

BY

H. E. YOUNG

GENERAL.—

Oidium Leaf Disease is caused by one of the powdery mildew fungi. The fungus in this case is named *Oidium heveae*. The disease can occur with disastrous effects in all the rubber growing districts of Ceylon resulting in greatly reduced yields and even in actual abandoning of some areas, particularly those located above the 1,000 ft. contour.

In the higher localities the disease is often conspicuous throughout the year whilst in low country areas the disease is usually noticeable only at the time of refoliation.

The fungus attacks young leaflets during refoliation and usually results in leaf fall. In cases of light infection or when the leaves are more mature at the time of attack the results are a distortion and spotting of the leaflets. The spots become yellow and persist through the life of the leaflet, the discoloured area often dying and becoming brown and infected with secondary saprophytic fungi.

Severe attacks resulting in much defoliation have an immediate as well as long term effect on yield of rubber, results of investigations show that one complete defoliation may reduce the annual yield by 20% or more. Successive attacks increase this effect. Another important effect is the decreased growth rate which occurs with mildew attack. This is due to the reduction of leaf surface and hence starvation of the tree for carbohydrate materials together with a decreased transpiration rate. This lowered growth rate causes poor and delayed bark renewal resulting in a marked depression of yield when tapping of the renewed bark becomes necessary.

Repeated defoliations in one season, such as frequently occur in uncontrolled fields, result in depletion of reserve foods in the tree, this often causes dieback of twigs and branches, particularly in the upper parts of the tree, and scanty foliage production. Secondary parasites particularly *Botryodiplodia theobromae* then enter the dead tissues and are able to cause more serious damage by extending the dieback and even killing the trees.

It is not known as yet what exact weather conditions are required for epiphytotic out-breaks of Oidium but there are indications that a dry sunny refoliation period causes a light attack whilst an overcast wet period is conducive to heavy attack. This is possibly due to the killing effect of sunlight and dry air on the delicate spores and to the high humidity of the wetter weather favouring spore germination and development of the fungus. The effect of rain on the removal of fungicide from the leaves is also considered important.

In general, attack by all powdery mildews is favoured by high humidities, shaded conditions and favourable temperatures.

Oidium heveae was first reported in 1925 in Ceylon in the Kalutara district and is now firmly established in all the rubber growing areas. The intensity of attack varies from year to year and place to place with the climatic conditions occurring at the refoliation of each clone, and is normally severe at the higher elevations. In the low country the disease varies from mild attacks to very severe incidence such as may occur on the hills.

Causal Fungus :—

The causal organism (*Oidium heveae*) has very delicate spores which can only survive exposure to direct sunlight or dry atmospheres for a very short period. In consequence spread of the disease is gradual from leaf to leaf and tree to tree. It does not carry any distance in one stage.

The spores germinate in an hour or two on a plant surface but the germ tube will not enter a wet surface ; it grows away from it and withers off and dies. On a dry plant surface it grows towards the surface and causes infection by penetrating the surface tissue. In continuous wet weather only protected dry surfaces such as the undersides of some leaves and the hair covered flower shoots are subject to infection.

When a spore settles on a susceptible surface and germinates it is some days before any sign of infection is visible to the unaided eye although the fungus has already established itself. The germ tube is unable to penetrate the mature *Hevea brasiliensis* leaf cuticle and consequently mature leaves are immune to attack.

Method of Attack.—

This depends on the penetration of the leaf cuticle in its juvenile stage by the fungus mycelium. In the vast majority of seedlings and clones the leaf cuticle takes eighteen or more days to reach maturity from time of bud break. In one clone imported from Java by the Rubber Research Institute in 1940 the cuticle reaches maturity in ten days. This clone is LCB. 870 which unfortunately is a low yielder of latex producing between 5—600 lbs. per acre in the third year of tapping, but may prove of considerable value in breeding and for top budding purposes for resistance. A large number of crosses between LCB. 870 and high yielding clones have been made at the Institute and the progeny is on trial for further selection.

As it takes about five days for mildew attack to be visible it will be seen that the most dangerous part of any leaf history will be during the first half of the cuticle development period. If infected in the latter half of this period only spotting can result as the fungus will have an immune cuticle to attack, by the time it has got going. In the case of clone LCB. 870 the period is greatly lessened resulting in the comparative resistance of this clone to mildew attack. It is attacked slightly but grows so rapidly through the susceptible stage that damage is comparatively slight. Some clones such as Tj. 1 (which has a 22 day maturing cuticle) have a longer susceptible period and, weather conditions being favourable, are more severely attacked.

Clonal Susceptibility.—

Analyses of reports made on the incidence of the disease according to clones indicate that this is considerable. Such analyses are being continued each year in order to gain further data.

Clone Tjirandji 1 has shown itself to be the most susceptible of the clones in general large scale use. It is even more susceptible than BD.5 perhaps because of the later wintering habit of Tj. 1 as compared to BD.5 which is one of the earliest winterers.

Clones PB.86, PR.107 and HC.28 have proved moderately satisfactory compared to Tj. 1 and other susceptible varieties.

In general, late wintering clones are most severely affected. This is due to seasonal influences and the building up of the fungus population on earlier wintering varieties so that the late winterers become heavily inoculated. However if much rain or dry weather supervenes, the attack on the late winterers may be curtailed. Seedling rubber fields are frequently severely attacked due to the variation of refoliation times between the different trees causing a build up of infection and severe attack on the late wintering trees, plus infection of the second flush of leaves of the earlier wintering trees.

On the other hand, early wintering clones frequently escape much attack due to the small amount of infection present at the beginning of the refoliation season.

The Oidium resistant clone LCB.870 with its rapid cuticular development has remained free from serious attack even at 1,500 ft. elevation without any necessity to apply control measures. Even this clone however may at times suffer severely from the disease at elevations above 2,000 ft.

Seasonal Incidence of Mildew.—

Hevea mildew is known for its effects at the time of refoliation. The fungus however is present throughout the year in new shoots. Owing to the comparatively sporadic production of these in low country areas and unfavourable weather conditions the fungus is not usually noted unless especially sought after. It occurs as isolated poorly developed spots on young leaves here and there throughout the canopy and on young volunteer seedlings. With the onset of favourable conditions and a plentiful supply of suitable leaves for growth it rapidly propagates again. In some areas at high elevations refoliation is irregular throughout the year with the result that the disease is always present and often severe.

Alternate Hosts for Oidium Heveae.—

The causal fungus is also to be found on a common weed on which it is present throughout the year. Climatic factors do not affect the development of the fungus on this weed as much as they do on Hevea. The leaves of the weed are clothed with plentiful long fine hairs which prevent wetting of the leaf surface and the spores of the mildew are able to infect the leaf surface despite continuous wet conditions. Hevea leaves can be infected with the fungus from this weed causing typical leaf fall. The fungus on the weed is *Oidium heveae* and the weed is *Euphorbia pilulifera.* L. (Syn. E.hirta ; Sinhalese — Budadakiriya ; Tamil — Palavi). This plant belongs to the same laticiferous family as Hevea but is a low growing semiprostrate herb which frequents roadsides etc. It grows best under conditions of good drainage and little shade.

This weed is probably another method of inter-seasonal survival of the mildew. It is particularly common in the drier areas.

Mildew and Flowering.—

Hevea mildew can cause an almost complete flower drop. The stems of the inflorescences are hairy and provide a more protected surface for spore germination than do Hevea leaf surfaces. As with the leaves the effect of the mildew is superficial. It causes breaks in the cuticle and excess evaporation takes place through the broken surface resulting in the drying out of the affected flower stems and leaves.

The male flowers being on the sides of the flower shoots and the females terminal, the male flowers drop first.

If severe flower fall is caused it is usual for a further flush of flowers to appear later in the same season. This frequently escapes mildew attack due to the wetter conditions prevailing and decreased mildew population giving less chances of infection. When making hand pollinations of rubber extra precautions in regard to mildew control are necessary to prevent flower drop.

MANURING AND MILDEW.—

Manuring with nitrogen at the time of or just prior to refoliation is liable to produce an increased susceptibility to mildew attack by causing the development of soft thin walled leaves. This is a normal occurrence with other crops also.

This should not however be taken as an indication that rubber should not be manured as manuring is important for growth, bark renewal and probably yield. In addition the available method of direct control by sulphur dusting should be sufficient to prevent Oidium damage.

Manuring cannot take the place of direct control of the disease. The practice of applying large quantities of nitrogeneous fertilizer immediately before wintering as is done on some few estates must however be considered a dangerous habit. It must be understood that unless there are plenty of leaves on a tree there is little to be gained from heavy manuring as the tree in that state can use but little of it, if however there is an abundance of foliage the trees can effectively use the mineral nutrients to advantage.

If an estate finds that it is financially impossible to apply Oidium control measures over its entire area it should not choose between either sulphur dusting or manuring but should carry out both operations on the most valuable fields as far as funds permit.

CONTROL OF OIDIUM.—

(*a*) *Direct Control.* The cheapest and most effective way of combating a plant disease such as Oidium is by growing resistant plants provided their yield is as satisfactory as average high yielding non resistant material.

Up to the present no such varieties are available in the case of rubber in regard to Oidium though a commencement has been made to produce this material by breeding. Clone LCB.870 is highly resistant but only of moderate yield by modern standards.

An alternative to growing a resistant high yielding clone is to crown-bud a high yielding clone with a mildew resistant top. The cost of crown-budding is at present rather high but may be reduced by adopting a system of hedge or avenue planting or by reducing the height of crown-budding from 8 ft. to 6 ft. The latter alternative would allow the budding to be carried out at a younger stage, as well as reducing the cost of the operation.

Reduction of the crown-budding height may possibly have an unfavourable influence on yield and until our present experiments in this regard can be completed it is not advisable to reduce the height of budding.

The crown-budding operation is described in advisory circular No. 32.

It should be pointed out that in those countries where *Dothidella ulei*, the South American Leaf Blight is present the high yielding rubber trees can at present only be grown by crown-budding them with disease resistant

crowns and this must continue until high yielding clones resistant to this disease can be bred. It is of interest to note that some of the hybrids already made are resistant to both Leaf Blight and Phytophthora disease. Material of South American Leaf Blight resistant clones will shortly be available in Ceylon for breeding purposes. If this material also proves resistant to Oidium its use in preference to LCB.870 for crown-budding will be an obvious move in order to guard against both the entry of Leaf Blight, and the presence of Oidium and also possibly Phytophthora.

Hedge systems of plantings should be considered for all plantings in Ceylon not only because the cost of crown-budding will be reduced but also because the applications of fungicides would be made easier and cheaper. It could also be expected that the hedge or avenue system would make conditions for the growth of Oidium less favourable due to better air circulation with resulting lower humidities in the plantation. No adverse effects on yield have been found by using the hedge planting layout though some clones are unsuitable for it due to their leaning habit when closely spaced. An instance of this is Tj. 16. A number of clones however do not show this undesirable habit.

(*b*) *Indirect Control.*—

(1) *Sulphur Dusting and Dosage.* It has been definitely shown both by the R.R.I.C. and commercial estates that dusting according to the R.R.I.C. recommendations with five rounds at weekly intervals using 12 lbs. of suitable dusting sulphur per round gives a satisfactory control of Oidium on average clones under average conditions but that this is unsatisfactory in the case of more sensitive clones. If the incidence of Oidium is light the standard dosage as above gives good protection but in severe cases of infection the protection is not sufficient but dusting two days a week that is at 3-4 day intervals for 5-6 weeks using 12 lbs. of sulphur per acre per treatment round gives good control in severe cases.

Lower dosages have been shown by experiments and experience to be relatively ineffective in normal cases.

Dusting should commence when 10% of the trees in the area show new growth, *i.e.* when green ends are appearing on last year's twigs. It is bad practice to wait till the new leaves are visible. If dusting is delayed until the new leaves are falling due to Oidium damage it will be too late to protect most of the visible leaflets and the disease will be well established in the field. Sulphur dusting is mainly preventive, not curative.

Dusting should continue until 90% of the trees have passed the sensitive stage.

For areas in which wintering is simultaneous and during fine weather the rate of application should be 12 lb./acre/round.

If wintering is a protracted affair, it may be necessary to direct the dust to single trees or groups of trees needing treatment while other trees which are not yet in the sensitive stage or have already passed it, are left undusted. If the weather is showery it is advisable to use small quantities as frequently as the rains permit.

Areas which have suffered badly from Oidium in the past and are in bad condition may need dusting for several months in order to protect the irregularly appearing new flushes.

From the above it is clear, that no hard and fast rules can be given for dusting. The superintendent must watch the weather and the kind of wintering, and act accordingly.

The use of dust stickers in the sulphur and other forms of dusts varying from the simple sulphur dust have so far not proved superior to the usual dusting sulphur specified for Oidium control in rubber. The use of other fungicides mixed with the sulphur dust may after further experimentation give improved results.

THE SULPHUR DUSTING OPERATION.—

Material Used. A sulphur to be suitable for use in Oidium control in rubber plantations must have the following minimum requirements when used in the dosages recommended.

(1) Be free flowing

(2) Contain a minimum of 85% pure sulphur.

(3) At least 90% of the sulphur must be capable of passing through a 300 mesh B.S. sieve or a 325 mesh A.S.T.M. sieve *i.e.* the particle size must be fine. This is most important. The finer the particle size within limits the better the fungicidal value of the dust and also the more sulphur particles per given weight. Fine particles adhere to the leaf surfaces better, they float better in the air and, being more of them, they produce more particles per leaf area than coarser dusts, with consequent better fungicidal effect. Sulphur kills the mildew by volatilization of the sulphur and therefore the larger the surface area of the particle compared with its mass, the better the volatilization. Sulphur for dusting purposes should be able to pass through a 300 mesh sieve (U.K. specifications) or a 325 mesh sieve (U.S.A. specifications) *i.e.* the largest particle should not exceed 47 microns in diameter (1 micron = 1/1,000 of a millimetre). Very fine particles *i.e.* those below 5 microns in size are unlikely to settle on a leaf surface and usually float away in the air. Particles above 47 microns in size are too large and do not stick to the leaf surface. They also fall rapidly from the dust stream.

In most products inert diluents are added for the purpose of making the dust more free flowing by preventing aggregation of sulphur particles.

The rate of application for sulphurs of a different grade of fineness and sulphur content to that specified should when used be calculated as follows :—

$$\frac{85}{S} \times \frac{90}{f}$$ recommended rate of application (*i.e.* 12 lbs. per acre).

S = percentage of sulphur in the fraction passing the standard sieve *i.e.* the fine fraction.

f = percentage size of the fine fraction.

The free flowing qualities of a sulphur may be judged by shaking about 4 ozs. of the sulphur in a dry glass jar. The sulphur should behave like fine wheat flour and show no tendency to form lumps or stick to the glass. Drying in the sun sometimes overcomes poor flowing characters. Dusts which are not free flowing cause irregular output of the dusting machine used.

Dusting machinery. Sulphur is applied to the trees by power driven and usually manually carried machines. There are several suitable types of dusting machines on the market made especially for the purpose of dusting

rubber plantations. The fan speed of the machines should be between 2,200 and 2,400 r.p.m. Some machines may be equipped with either of a choice of two power units. The reliability of the machine and the weight of the unit varies greatly with the type of engine installed.

Machines fitted with the so called " directional duct " are useful if trees standing on a steep slope below the path have to be dusted. Machines fitted with a straight duct send the dust higher but require a much closer spaced access path system.

Dusting Paths. In order to be able to dust efficiently over the whole area and to do " spot-dusting " where required, it is necessary to have footpaths not more than 100 ft. apart. Although the cloud may be seen to drift over great distances, the area effectively covered will rarely be more than 200 feet from the machine and 100 ft. is a safe average. If the terrain is difficult and the mere carrying of the machine is a laborious task, the efficiency of the dusting must be expected to suffer and much valuable sulphur may be wasted, at the same time leaving the trees insufficiently protected. Chipped paths suitable for access where required are quite cheaply constructed and save their cost in time and efficiency of dusting.

The Dusting Operation.—

The literature on the subject of application of fungicidal dusts stresses that dusting should be carried out (*a*) in still weather and (*b*) when the leaves are still wet from dew. These two points are too often neglected. Many estates have up till now followed the routine of not commencing dusting until after 10 a.m. because from that time onwards the dust " rises better " and is carried farther with the wind. In practice in Ceylon deviations from an early dusting programme have usually resulted in unsatisfactory results.

Objections against this practice are:—

(*a*) When the sulphur particles are deposited on a dry leaf surface, adhesion is very poor.

(*b*) Late in the morning upward convection currents are prevalent and a good deal of the dust is carried up above the tree tops away out of the area to be treated.

(*c*) Later in the day the wind often becomes too strong to allow any dusting at all.

It has in some cases in Ceylon become a fetish to blow the sulphur dust as high as possible above the tree tops. This is defeating the whole purpose of the treatment as the dust then gets into the higher wind velocity area and convection currents and mostly drifts away without depositing on the leaves it is intended to protect.

In dusting the aim is to obtain a cloud which drifts laterally *through* the trees more or less parallel to the land surface. Not *over* the trees where it is useless.

Conditions for dusting may on some days and in some locations remain suitable for dusting until close upon midday, but this is not the rule. One should set out to complete the day's dusting between 6 and 8 a.m. If this is not possible, dusting may be continued until later *but only under the strictest*

done 33 p 25

supervision. Dusting programmes must not be based on late dusting. Late dusting should be seen as an emergency in order to make up for unforeseen circumstances and in any case it would be better to wait until early the next morning.

In the above, mention was made of the wind. Wind is a very important factor in dusting. *The machine should never be moved against the wind while dusting nor should the machine be moved faster than 2 m.p.h. in still air.* If there is a light wind, the machine may move in the same direction as the wind or directly across it. The man in charge of the dusting must always try to keep his machine more or less under the dust cloud, because only if the power of the machine is kept under cloud, will the dust go up high enough.

This implies, that if the machine is in a downwind position in relation to the area to be treated, the machine cannot be moved to an upwind position while dusting. If the wind is light, the machine may be carried with the feed closed for about 100 feet to be put down for about 10 seconds dusting after that the feed should be closed again and the machine moved another 100 feet for some more dusting. If transport of the dusting machine is mechanized, it will be easier to drive to the windward side without dusting and to come down the same road with the wind, dusting and keeping the machine under the cloud.

It may be thought by superintendents that when a cloud of sulphur is seen in the trees at a greater distance from the machine than about 100 feet that this cloud is doing effective dusting. This is not the case. By the time the sulphur cloud has travelled that far, the particles which are able to adhere to the leaves and control the fungus have settled out and all that remains is very fine particles which cannot exert control as they cannot by reason of their small mass adhere to the leaves.

Intelligent and close supervision is essential for effective dusting.

RESTING OF THE TREES DURING WINTERING.—

Under Ceylon conditions resting during wintering appears to be essential. If resting is omitted an increase in the number of brown bast trees must be expected and also the rate of refoliation will be much slower, thus exposing the trees for a longer period to the influence of Oidium. In addition with no resting the development of full foliage is likely to be reduced and bark renewal impeded.

In this connection it must be pointed out that the purpose of resting is to stop the drain on the tree's reserves at the time when it needs them most *i.e.* for growing new leaves when it has no functioning leaves to provide energy.

The best thing to do would be to rest each tree for four weeks from leaf fall. As this is however impracticable it is recommended to rest each clearing as soon as budbreak has started in about 20% of the trees. To rest the whole estate as one unit is not recommended. If that is done, some fields will be rested when it is too early and others when it is too late for the rest to have maximum value.

DUSTING OF BUDDED RUBBER AND SEEDLINGS.—

The time of defoliation in a stand of one clone is much more uniform than in a field of mixed seedlings. In some clones notably Tj. 1 there is a tendency for different branches of the same tree to winter at different times and in such cases wintering may be as prolonged as in a seedling field.

The uniformity of wintering within monoclonal blocks is favourable to the control of Oidium owing to the shorter period during which the foliage is susceptible to attack. On the other hand if dusting is at all delayed in such a case a large proportion of the new leaf may be lost before control can, with difficulty be established.

In the case of blocks planted with clonal seed the wintering period will be prolonged as in the case of mixed seedling rubber and dusting operations must therefore also be prolonged.

(2) *Control by Spraying.—*

In 1953 the R.R.I.C. found that spraying with either wettable sulphur at 4 lbs./acre/week or with lime sulphur at 1½ gall./acre/week gave practically complete protection on the trees which were actually sprayed. In order to reach all trees it was necessary with the then available machine (Micron-sprayer) to take it along every second row. It was hoped, that if more powerful machines would become available a much greater depth of treatment could be achieved so that a swath-width of about 100 ft. could be obtained.

In 1954 two large mistsprayers were available to the Institute, one was Messrs. Drake and Fletcher's " Mistejecta " and the other Messrs. Birchmeier's " Biatom III." Both of which are expensive in initial cost.

In this season it was again found, that the trees actually reached by the spray remained virtually free from Oidium, but it was also found, that the depth of treatment (range) even of these big machines was not more than between 60 and 70 ft. Also it was found, that in order to obtain the necessary range and a sufficiently dense coverage, the forward speed of the machine should not exceed 1 m.p.h. This limits the capacity of the large machines mentioned above to 8 acres per hour (in ordinary square planted rubber). Hence although spraying again proved its efficacy as a method of Oidium control, the application difficulties appear to be even greater than was anticipated.

For such machines which require a tractor to pull them suitable roads at distances apart of about 100 feet are required.

(3) *Spraying and Dustng.—*

The control achieved by dusting twice a week at 12 lbs. per acre per dusting is similar to that obtained by spraying with wettable sulphur or with lime sulphur in various formulations.

The cost of dusting is on the average Rs. 4/– per acre per round when the price of sulphur is 25 cents per lb. The area treated in one hour allowing for walking speed of 1½ m.p.h. and a depth of treatment of 100 ft. is about 20 acres. With two effective hours of dusting a day the area treated is 40 acres per day. *i.e.* one machine can cope with 240 acres of dusting per week if all the rubber wintered together, this however does not occur and one machine for one round per week could treat about 300—350 acres at 2 rounds per week the machine would cover half this.

The capacity of a spraying machine of the types experienced is estimated at 50 acres per day with no breakdowns *i.e.* the machine could be expected to cope with 300 acres per week. The cost of this operation will be Rs. 12/50 per round plus the cost of roads.

One round of spraying is therefore at present three times the cost of one round of dusting, and even with severe attack when two rounds of dusting per week are necessary, the cost of the spraying will be 50% greater for the same return.

Unless therefore an entirely new type of sprayer becomes available, and which would be cheaper to operate, spraying cannot be considered for a commercial estate.

On Estates at very high elevations where dusting is not too satisfactory spraying could be considered. In the case where avenue or hedge planting is in existence spraying costs would be slightly less than those shown above which were worked out for normal square planting.

(4) *New and Promising Fungicide.*—

For the first time since the discovery of sulphur as a ungicide against powdery mildews a new chemical has been developed of which it is claimed that it is especially effective against the Oidium fungi. The name of the new chemical is " dinitrocaprylphenylcrotonate ; " it is also known under the trade names " Mildex " and " Karathane." Experimental quantities were obtained from the U.S.A. and the initial experiments, using the substance as a spray as well as mixed with dusting sulphur have been encouraging. Experiments will be carried out on a larger scale in the Moneragala area. The necessary quantity of the chemical will be imported by one of the Colombo firms, who are agents for this fungicide. If the experiments referred to prove successful larger quantities will probably be available for more experiments in future seasons.

(5) *Spraying from the Air.*—

Although dusting from the air for control of Oidium had been carried out on a trial basis in Indonesia many years ago spraying had not been tried. For technical reasons dusting with sulphur from the air is not now practicable.

The Rubber Research Institute in cooperation with the Planters' Association of Ceylon and subsidized financially by the Ceylon Government arranged with a British contracting firm to carry out a spraying trial on an area of approximately 2,500 acres of rubber in 1954. The materials used for spraying were lime sulphur formulations prescribed by the R.R.I.C. In general the results of the trial were unsatisfactory as aerial spraying did not exert as much control as did ground spraying, or dusting according to disease requirements, and was much more expensive. The machines used were helicopters and a small fixed wing aircraft.

General Recommendations

For the control of Oidium the Rubber Research Institute of Ceylon at present recommends that commercial control of Oidium on rubber estates in Ceylon should be carried out as follows and according to the principles described above :—

(a) One round of dusting with suitable dusting sulphur per week at 12 lbs. per acre in the case of light attacks of Oidium.

(b) Two rounds per week at 12 lbs. per acre per round in the case of heavier attacks.

(c) One machine per 300 — 350 acres in case of *(a)*.

(d) Two machines per 300 — 350 acres in case of *(b)*.

(e) As the occurrence of *(a)* and *(b)* cannot be predicted, a safe estimate, to provide for 50% of the dusted area to be dusted twice a week and the rest once a week, would be to provide 1 machine for each 250 acres and sufficient sulphur to dust at say 1½ times the normal rate of 12 lbs. per acre for each of 5 to 6 rounds.

TAPPING OF HEVEA RUBBER

by

C. A. DE SILVA

Introduction

In deciding the best system of tapping on a long term policy the question of bark conservation has come to the forefront in recent years. Economically the best tapping system is one which gives the highest yields with the minimum bark consumption and without bark disease. It has been convincingly proved that yield is taken at the expense of growth. The introduction of the " Full-Spiral " and " Double-Four " systems at the commencement of tapping results in a marked set-back to growth. On older trees this set-back is less immediately apparent, but any method of tapping resulting in greatly increased yields must, in the long run, affect adversely the bark development during the first and second tapping cycles. In Ceylon, Oidium leaf disease insufficiently controlled, and poor growing conditions are added contributory factors to poor bark recovery. The choice of a suitable tapping system must be, primarily, a judicious compromise between the two interacting factors yield and growth. During the early years of tapping consideration must be given to the incidence of Brown Bast on high yielding clones and clonal seedlings. It is best to take the long view and train the trees during the early years of tapping to their ultimate work of producing economic yields throughout their tapping life. In the following recommendations all practical points of immediate importance are shown in italics under appropriate headings :—

Standard of Tappability

Both budded and seedling trees can be regarded as tappable, when they have attained a girth of 20 inches, at a height of 3 ft. from ground level for seedlings and from the highest point of the union in the case of budgrafts. These recommendations compare very favourably with those of other eastern rubber growing countries, which have been based on the experience of over 25 years tapping.

A new field is brought into tapping, when approximately 70 per cent. of the trees have reached tappable girth. An exception is shown later for the case of dense stands of clonal seedlings under the heading of " Tapping Systems " for the purpose of selective thinning.

An increase in the standard of tappable girth will result in loss of crop due to postponement of tapping. Any attempt to counter this by a reduction in the percentage of tappable trees for commencement of tapping will spread the tapping task over 3 or more acres resulting in a loss of crop due to late tapping in the tail end of the tapping task. The difficulties of supervising such an extended tapping task are obvious under present conditions, especially in regard to the collection of latex on tapping days interfered by rain.

Tapping Systems

Budded Rubber.— There is no one system which is best suited to all clones under all conditions. Where conditions of growth are poor the high yielding clones are best tapped on the reduced intensity of 67 per cent. for the first 3 years, and after this period is completed it should be possible to assess the risks of increasing the tapping intensity involved in any particular area. The early incidence of Brown Bast will be a guiding factor.

For most clones the alternate-day half-spiral system of 100 per cent. intensity will be satisfactory for commencement of tapping especially in the wet low country districts. In the case of clone Glenshiel 1 a 67 per cent. intensity tapping should be adopted permanently.

In the case of moderately high yielding clones, which do not show a high incidence of Brown Bast, the double-four system of tapping can be introduced in the fourth tapping year when increased yields at a considerably lower tapping cost can be expected.

Some high yielding clones can be tapped on the double-four system in the second tapping cycle, if the percentage of Brown-Bast cases has not been unduly high. This is particularly applicable to the wet low-country districts.

Clonal seedlings.— It is increasingly evident that high yielding clonal seedlings can show a high incidence of Brown Bast during the early years of tapping. *A 67 per cent. tapping intensity is recommended for the first 3 years of tapping, which will include the test-tapping period for selective thinning out on early yields,* as recommended later in these notes in place of the Morris-Mann system of early tapping.

The initial high cuts on seedlings are an added advantage, as these tend to restrict yields during the early tapping years and thus obviate the occurrence of Brown Bast.

In the case of clonal seedlings planted at well over 200 points per acre, the thinning out in the early years before the commencement of tapping is carried out on growth and other secondary characters. It is unlikely that the Morris-Mann system of early tapping will be adopted generally at the end of the 4th tapping year when the girth is 12 inches and over, especially among the middle class estates and small-holdings. *The tapping of high stands of clonal seedlings can be undertaken when the average girth is 18" at a height of 3 feet from ground level on 70% of the total stand. The tapping should be carried out on a 67% intensity on the S/2, d/3 system for three years during which time the poorest yielding trees should be eliminated together with trees showing advanced symptoms of Brown-Bast.* The permanent stand, can then be tapped on the alternate day half spiral system at 100 per cent. intensity. *The minimum requirements for stand per acre of Tjir.1 clonal seedlings for small-holders, under the Subsidy Scheme, are not based on any system of selective thinning as indicated above, (Leaflet SH. 6)* whereas the stand of 250 per acre for other classes of clonal seedlings is.

A short description of the " Morris-Mann system of test tapping will be found on page 69.

Bark Consumption and Height of Tapping Cuts

In Ceylon the Michie-Golledge knife is in general use. Bark consumption and tapping heights for a particular tapping cycle are based on 20 tapping cuts per inch of bark.

The bark consumption for any tapping year will vary according to the total number of tapping days. There is no evidence to prove that thicker shavings give increased yields. For a given interval of tapping depending on climatic conditions, the latex vessels should be effectively opened for the free exudation of latex. Somewhat thicker shavings are necessary after periods of rest, and if a four-day interval is adopted in the drier districts due to drying out of the cut surface to a greater depth. The double-four system is not normally recommended for the Galle and Matale districts on this account.

Working on a basis of 280 tapping days per year the bark consumption will be as follow :—

Tapping Interval.	Cuts per tree per year.	Bark consumption per tapping year.
Once in 2 days	140	7 inches
„ „ 3 „	94	4·7 „ (5 inches)
„ „ 4 „	70	3·5 „ (4 inches)

In the three and four day systems a slightly higher rate of bark consumption can be expected due to the increased interval of tapping, especially during the drier periods, and the consumption per year will be more nearly 5 inches and 4 inches respectively, which are indicated in brackets.

As compared with seedlings the yields of budded rubber do not decrease with increasing height to the same extent. Budded trees can, therefore, be tapped higher up the panel without a great loss in crop. In seedling trees the lower half of the tapping panel has a higher concentration of laticiferous tissue, as well as a greater length of cut compared with high cuts due to the taper of the trunk. It is, therefore, a definite advantage to keep the cuts low. We also think it undesirable to leave isolated patches of untapped bark at any stage of the tapping history of a tree. In keeping with these views the initial cuts on both seedlings and budgrafts are opened at maximum heights, which will cover the maximum rate of bark consumption for any recommended system of tapping on a minimum renewal cycle of approximately 8 years.

In our present recommendations no provision is made for the reduction of tapping heights to conform to the reduced intensity of tapping at 67% intensity, and the maximum heights given below provide for 70 inches of tappable bark, 35 inches on each half circumference panel on the main stem (*see* diagram No. No. 1). The tapping on a 67% intensity is a temporary phase, which is followed by 100 per cent. intensity tapping on a double or single cut system. *An area of 6 inches of bark, according to the angle of the cut should be left untapped immediately above the union in the case of budded trees.* There is evidence that decreased yields may be obtained depending on stock-scion influence, and the clone, when the cut is close to the union. It is best to avoid such fluctuations in the first tapping cycle. In commercial practice this untapped bark on individual trees may vary from 4 to 7 inches at the time that the cuts are due for a change over to the opposite panel, according to the somewhat variable consumption of bark by tappers, within a clone or tapping field. All cuts are, however changed, over at the same time.

It should be stressed that a tapping rate of so many *inches per month or per year cannot and should not be adhered to if rational tapping is required.* The criterion of tapping is 1/20 inch of bark per tapping, not a fixed bark consumption per month. The number of cuts per month varies with the number of tapping days *i.e.* in a wet month with few tapping days only No. of tappings × 1/20th inch of bark should be consumed. The practice of marking on the tree the amount of bark to be consumed per month is dangerous in this respect, as in a wet month the tapper is likely to cut thick shavings, and thus waste bark in order to use up the marked amount. If any markings are made they should merely be used to indicate a maximum for the period concerned.

Tapping Heights and Slope of Cuts

Clonal Seedlings.— Tapping cuts should be opened at a height of 35 inches from ground level to the lower end of the tapping cut. The angle of the cut from the horizontal should be 22½ degrees and must slope downwards from left to right. This angle is sufficient for the satisfactory flow of latex along the thicker bark of seedlings as compared with that on budgrafts. The angle of the cut compared with that in budgrafts leaves a smaller triangle of untapped bark at the base of the tapping panel, thereby providing for a maximum amount of tappable bark in an area, which gives the best yields on seedling trees (*see* diagram Nos. 1 and 2.).

Budded Rubber.— Tapping cuts should be opened at a height of 41 inches from the highest point of the union to the lower end of the tapping cut, the angle of the cut from the horizontal is marked at 25° to 30°. The steeper angle is used in the case of

clones which show somewhat thinner bark than those normally selected. The area of untapped bark left over at the base of the panel is of no consequence, as this often gives reduced yields and rarely exceeds those obtained from higher up the tapping panel. (*see* diagram 1).

In commercial practice two stencils are made of aluminium sheet for budded and seedling rubber. These are used to mark the trees with the correct angles for the cuts and the rate of bark consumption allowed for the tapping year.

Cuts on trees not initially taken into tapping due to poor girth development must be opened at the maximum heights adopted for the rest of the stand and not at the existing heights of cuts on trees initially tapped. Opening new cuts at existing heights defeats the purpose of our recommendations, as the undesirable. " island " of virgin bark will appear during the course of the tapping history of such trees.

Change over Systems of Tapping Cuts

We recommend the change over in diagrams 3 and 4, primarily, for making provision for tapping on a double-cut system after the end of the 3rd year of tapping. *The first change over is made at the end of the third year on S/2, d/2, 100% system in a 10 year cycle, thereafter, an annual change over should be made* (*see* diagram 3). On a reduced intensity the first change over is made if necessary, when the bark consumption has reached one quarter of the consumption on a 10 year cycle based on 100% intensity tapping or half way down a single tapping panel of tappable bark.

If there is no intention of tapping on a double-cut system in the future, tapping should be continued down the whole length of the tappable bark on the first panel, before the change over to the maximum height on the opposite panel. It is possible on the above system to introduce a double-cut system at the end of the 8th year. The " double-four " system is of considerable importance for future tapping, as it is the cheaper system on both task size and latex production compared with the standard alternate-day half spiral at 100% intensity. The change over when made as recommended provide for the cuts remaining widely separated and ready for the double-four system.

If the single cut is retained on the change over system an alternate system is given in diagram 4 for use at the end of the eighth year of tapping.

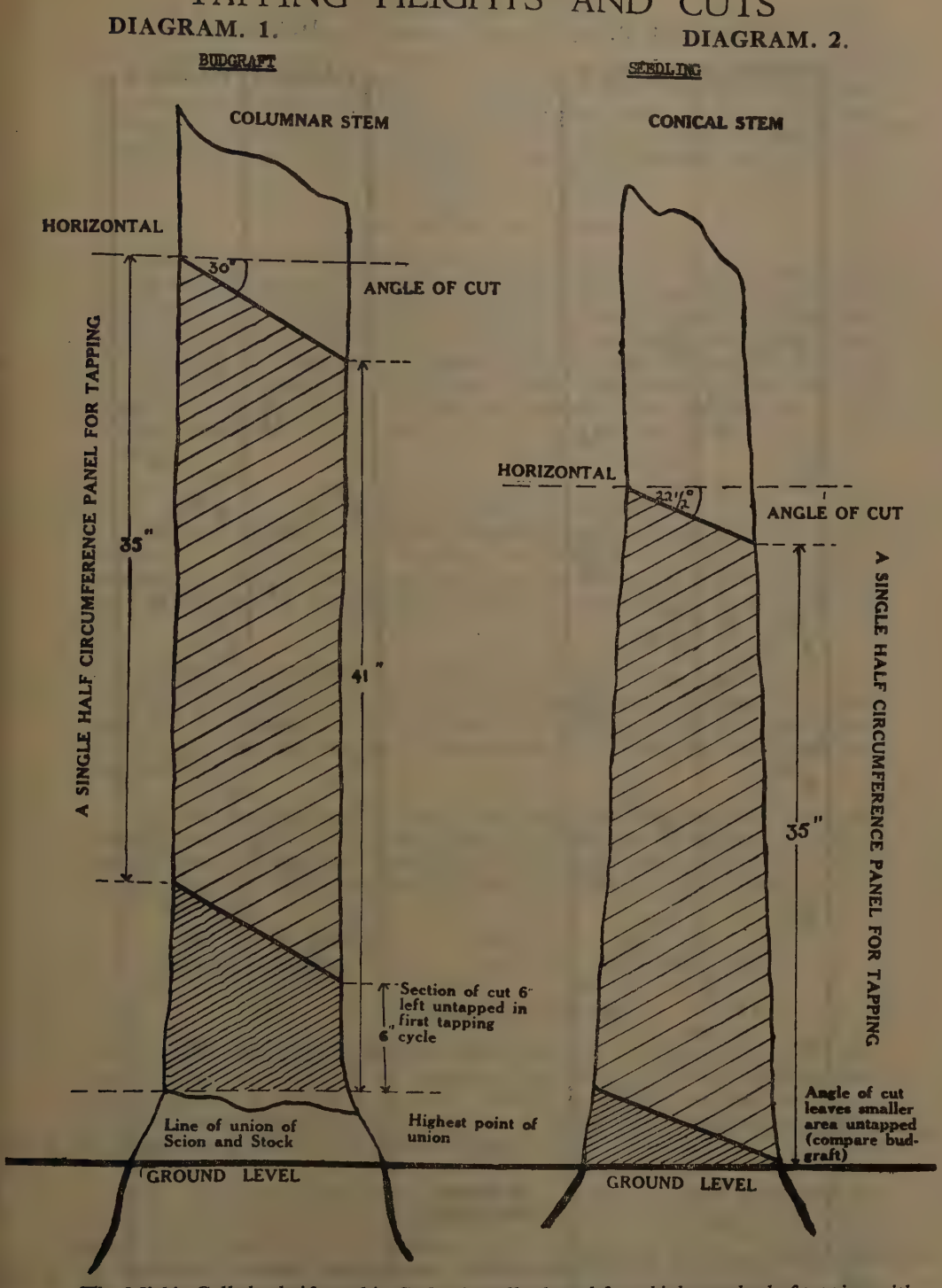
Depth of Tapping

It is known that the most active latex vessels are concentrated close to the cambium in the soft bark. The outer bark with the characteristic " stone-cells" contain the less efficient, sparsely distributed, and discontinuous latex vessels. *The best yields are obtained by tapping to a depth of within 1 to 2 millimeters of the cambium.* The best tappers do this without injuring the cambium. The absence of these injuries on tapping panels is not always a sign of good tapping as this may be due to too shallow tapping which gives reduced yields.

Direction of Tapping Cut

The latex vessels run at a slight angle from right to left down the stem that is, in an anticlockwise spiral upwards. *The greater number of latex vessels are cut, when the tapping cuts are made from high left to low right.* Experiments have shown that an average decrease of about 13 per cent. may result if the cut slopes in the other direction that is from right to left.

TAPPING HEIGHTS AND CUTS



The Michie-Golledge knife used in Ceylon is well adapted for a high standard of tapping with a minimum consumption of bark. It calls for a certain dexterity in guiding the cut correctly and gives a cleaner cut than the types of draw-knife used in other countries. The average tapper will find it difficult to work on cuts above 41 inches high as the top end of the cut will be beyond his reach for downward tapping.

CHANGE OVER SYSTEMS FOR SINGLE HALF SPIRAL CUTS

DIAGRAM. 3.

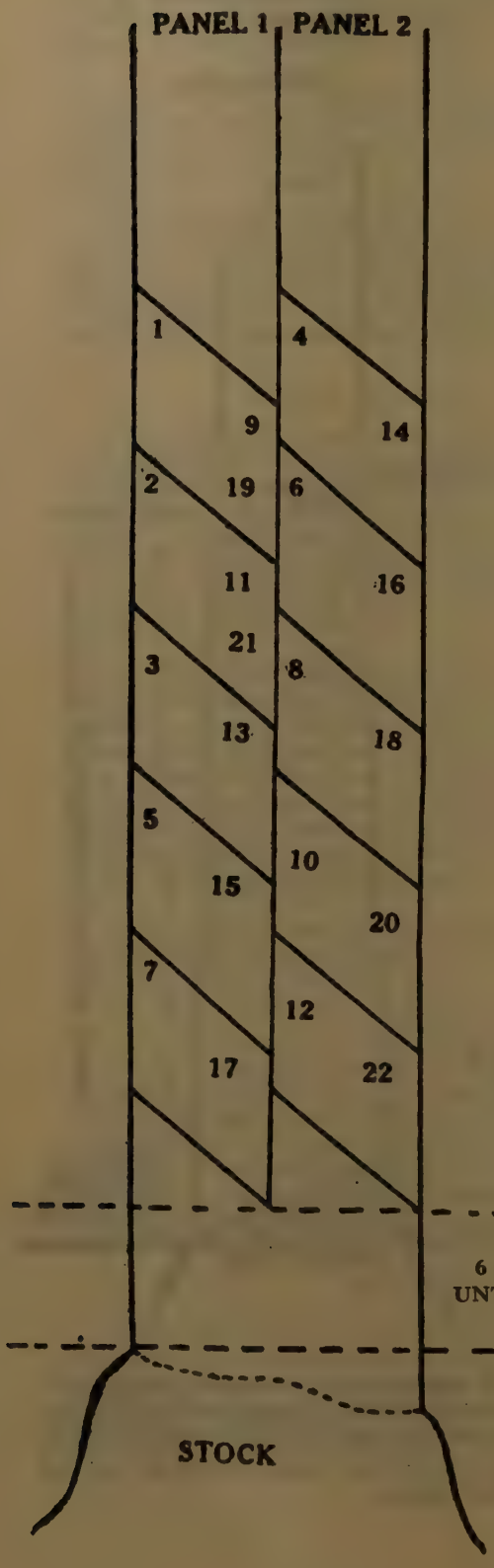
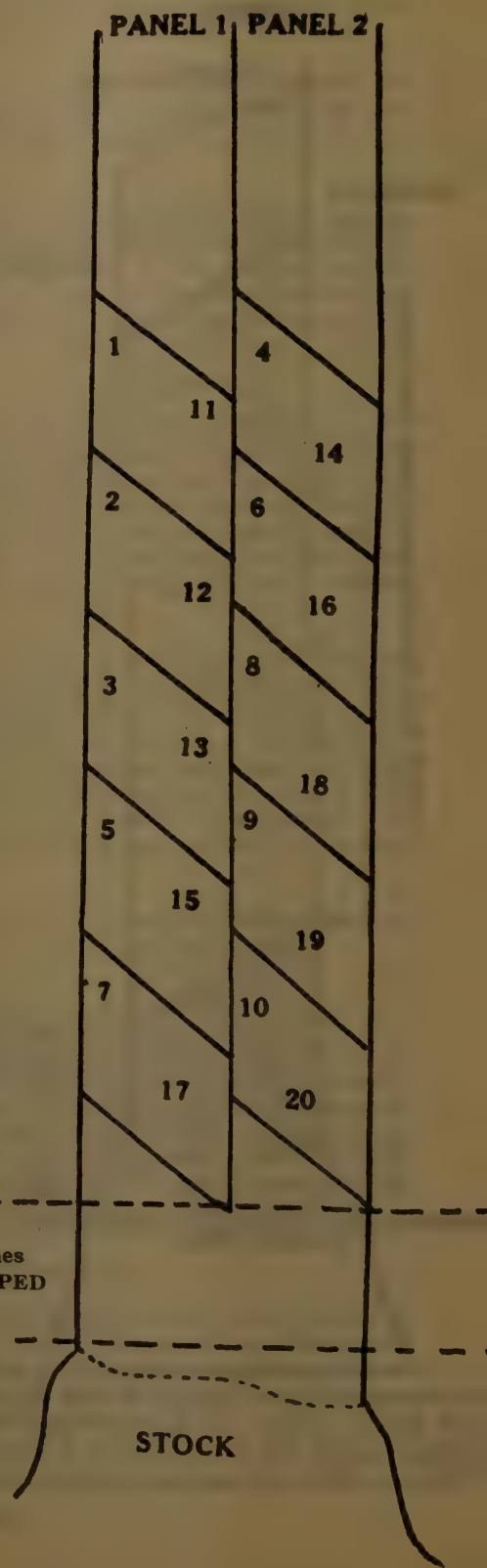


DIAGRAM. 4.



The drawknife is well adapted for high tapping and the bigger task. Ceylon can ill afford the higher rate of bark consumption associated with the use of this type of knife. It is used for quick tapping on large tasks, generally on a contract basis in Malaya. The conditions of growth for bark renewal are poorer in Ceylon due to soil conditions and incidence of leaf diseases. It is unlikely that this type of knife will come into favour in this country for normal tapping on fixed tasks, which is invariably carried out by resident labour.

Time of Day of Tapping

The latex production of Hevea is at its highest in the early hours of the morning, and the later the commencement of a day's tapping, the smaller the amount of latex obtained. The pressure for exudation of latex is highest during the night and in the early morning as the humidity of the air then is at its maximum and transpiration, which entails the loss of water through the leaves, is at its lowest. The loss of water by transpiration later in the day reduces the internal pressure resulting in a poor exudation of latex. In general the rate of decrease depends on the weather conditions of each day. This is also reflected in the soil moisture content.

The Tapping Task

Tapping and latex collection account for almost 40% of the total costs of production. It is essential, therefore, to evolve a satisfactory compromise between the size of the tapping task and the efficient intake of latex by a general study of the terrain of the rubber land and climate under local conditons.

In general we consider that 150 trees on the double-cut and 250 trees on the single cut systems per tapping day are satisfactory. The closer planting introduced in recent years on the "Avenue" and "Hedge" planting systems on difficult land presents considerable scope for greater efficiency of tapping with increased tapping tasks.

If the number of trees in a task is too large the production will gradually decrease, as the trees on an average will be tapped later each day. The hasty tapping of big tasks leads to a number of tapping irregularities for the want of adequate control. An experiment in Indonesia gave the following results :—

No. of trees per task	..	380	345	317	292	253
Percentage yield	..	100	106	109	116	119

Tapping Systems

(1) *Alternate-Day Half Spiral System S/2, d/2, 100%.*— On a 280 day tapping year each tree will be tapped on 140 days. The bark consumption will be 7 inches at 20 cuts to an inch. The 70 inches of tappable bark allowed on two panels will provide a 10 year cycle on budded and seedling rubber (*see* diagram 1).

(2) *The Double-Four System,* 2S/2, d/4, 100%, two half circumference spiral cuts are tapped once in four days. On a 280 day tapping year each tree will be tapped on two cuts on 70 days, each cut will take off theoretically $3\frac{1}{2}$ inches of bark per tapping year. An extra $\frac{1}{2}$ inch is allowed for the four day interval especially in the dryer areas, making a total consumption of 8 inches of bark on two cuts per year. 70 inches of bark allowed on two panels will provide a tapping cycle of approximately 9 years, which is quite satisfactory.

DIAGRAM. 5.

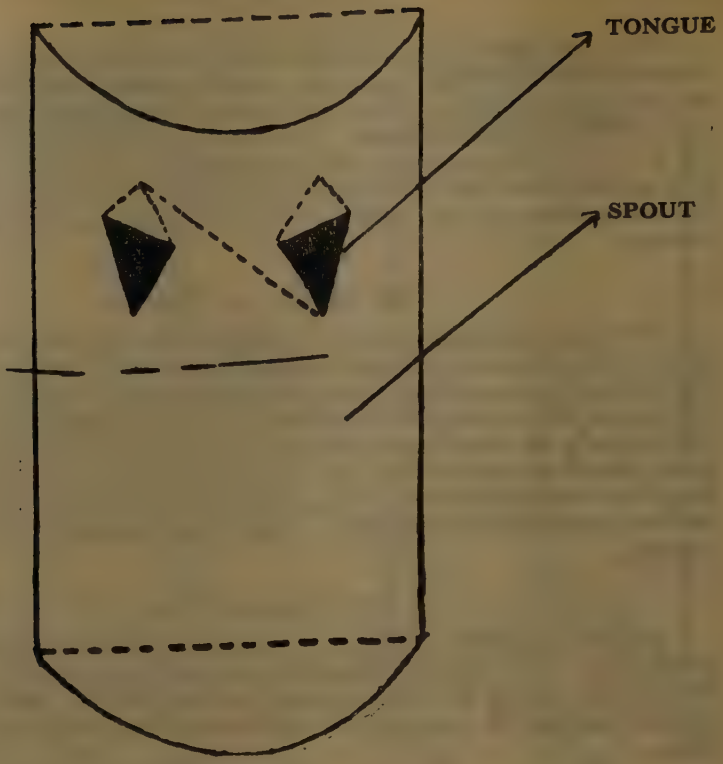
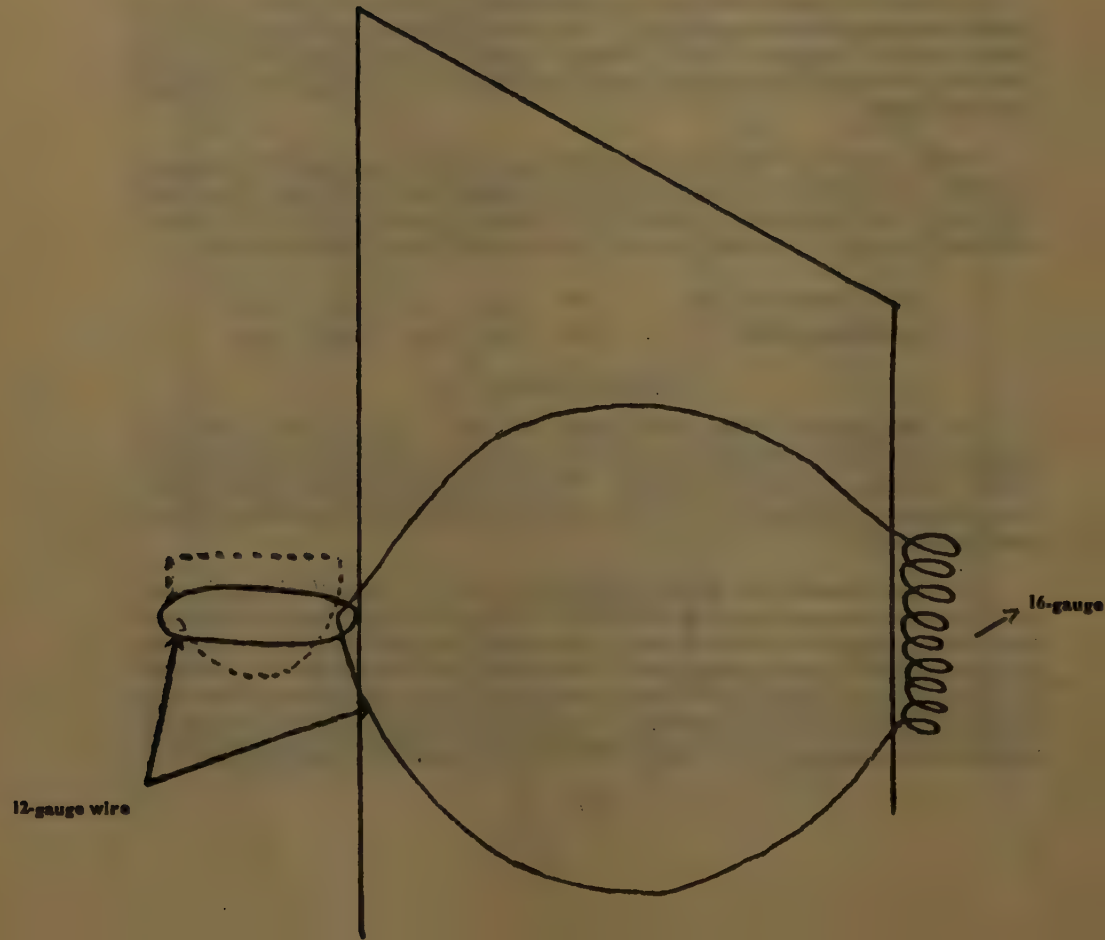


DIAGRAM. 6.



(3) *The Half Spiral Third Daily System, S/2, d/3, 67%.* One half circumference spiral cut is tapped once in three days. As recommended earlier this tapping system can be used in the first three years for both high yielding clones and clonal seedlings. Based on the yield results and the incidence of Brown Bast during these early tapping years, a decision can be made either to retain the system permanently, (as in the case of clone Glenshiel 1) or change over to system (1). On a 280 day tapping year each tree will be tapped on a single half spiral on 94 days, the bark consumption will be 5, inches per year. Except in the case of clone Glenshiel 1, the cuts are opened at the maximum height, for a possible change over to systems (1) and (2) in the future.

(4) *The Third Spiral, Alternate Day System, S/3, d/2, 67%,* a third circumstance spiral cut is tapped on alternate days. From a point of view of tapping cost it has no advantage over System 3, and yields obtained will be of the same order. The adoption of a higher intensity of tapping after the initial 3 year period will be a matter of some difficulty. Should planters decide to use system 4 in spite of the drawbacks mentioned above, they are advised to contact the Rubber Research Institute.

Spouts and Cup-Hangers

The bark of a budded tree is thinner than that of a seedling. To avoid unnecessary wounding certain modifications in the design of spouts and cup-hangers are necessary. Suitable spout and cuphangers are described below.

The dual purpose spout-cum-cup hanger is unsuitable for use on budded trees because it cannot be anchored sufficiently firmly to bear the weight of a cup full of latex without being knocked into the wood and thereby causing a wound.

Spouts should be as light as possible and suitable ones can be made of 24-gauge metal provided with two tongues to prevent them from penetrating to the wood. (Diagram 5.). The spouts should be pressed into the bark and not hammered in.

A suitable cup-hanger can be made of 12-gauge wire. The two ends should be joined together with a length of 16-gauge wire coiled into a spiral spring to allow for the increasing girth of the tree (Diagram 6). The type of cup-hanger which is kept in position by bending the ends of the wire at right angles and forcing this into the wood should not be used.

Appendix

Morris-Mann System of Tapping Clonal Seedlings.— In this system of early test-tapping, seedlings are tapped when about 80 per cent. of the number of trees in a stand in a field have reached a girth of 12 inches (diameter 4 inches) at a height of 20 inches from ground level. This stage is normally reached in 3 to 4½ years.

Trees with a circumference of 12 inches and over are marked with a left to right spiral cut at an angle of 30 degrees from the horizontal. The lowest point of the cut will be 20 inches from ground level. When the time comes for regular tapping a new cut can be opened on the opposite panel at maximum height and the original panel used for test-tapping will be left to renew for the normal sequence of tapping on the opposite panel.

Test tapping is carried out for 10 days. If rain interferes additional tapping days are included. The first 5 tappings are excluded from records. From the 6th to the 10th tapping each day's output of latex is coagulated in

the cups by adding a few drops of 5 per cent. acetic acid. The coagulated rubber in each cup is threaded on wire hooks and attached to each tree at a fixed height of about 5 feet from ground level. It is an advantage to use small cups if this is possible.

Test tapping may be done in the afternoons if desired and should be undertaken during a dry period, when interference by rain is least likely to occur, but this should only be carried out when all the trees in the particular field section being tested are tapped in the afternoon in order that the comparison required may be valid.

Selection of trees to be cut out is based essentially on the yield of each tree as indicated by the size of 5 test-tapping samples on the wire hooks. The thinning out must, however, be systematized as much as possible according to the method of planting by including for elimination, vacant points, poorly grown and mis-shapen stems and backward supplies.

Example

Seedlings which are planted 5' × 35' will give approximately 250 trees per acre. It is required to selectively thin this number down to 150 trees per acre of further development after 4 years growth for permanent tapping.

In the above hedge planting system it will be convenient to take groups of 5 trees and thin out the worst 2 trees. In the more square types of planting, where the trees are grouped together, 3 to 4 rows of about 20 trees in a group can be thinned out to 12 trees by eliminating 8 trees on yield and other characters as indicated below.

Vacant points ..	1
Poorly grown trees ..	3
Poorest yielding trees	4
Total ..	8

In the case of budded trees there is a close relationship between yield and growth, and if selective thinning out of high stands is necessary about the 4th or 5th years of growth, the poorest grown trees can be eliminated without test-tapping for yielding capacity of individual trees. *This does not apply to clonal seedlings.*

SALE OF BUDWOOD

by

C. A. DE SILVA

Authenticated supplies of budwood of the clones shown in the following lists, as well as a number of less well known clones, may be obtained from the Rubber Research Institute under the following conditions and on application to the Director of the Rubber Research Institute, Agalawatte.

Budwood is available for sale to purchasers in limited quantities normally not more than 5 yards of a single clone can be supplied to any one purchaser. The small quantities of authenticated material available to each purchaser are issued for purposes of multiplication by the purchaser for use on a large scale later.

Budwood can only be supplied as available and stocks of material are not necessarily available at short notice.

Purchasers of the following proprietary clones will be required to sign an agreement providing against redistribution of the material. These clones will, however, be available to all estates owned by any one purchaser to whom the budwood is supplied. Sales of RLD clones will be made on the understanding that purchasers will be required to plant out small scale trials of the clones issued as soon as the budwood is sufficiently multiplied, (normally about 1½ to 2 acres to cover a single tapping task).

Information on the performance of these clones is to be found in the Annual Report of the R.R.I.C.

Local Clones (for sale by agreement)

	Price per yard. Rs. cts.
RLD. No.'s 1 to 7 (Available in 1954)	3.50
RLD. No.'s 16, 17, 21, 22, 28, 29, 37, 36 (available in 1955)	3.50
RLD. No.'s 14, 41, 45, 46, 47, 51, 59 (available in 1956) ..	3.50

THE RLD series of clones is a new series developed by the R.R.I.C. in its breeding and selection programme and is the property of the R.R.I.C.

The R.R.I.C. has relinquished the agency for the distribution of the following proprietary clones as from 1st June 1954. Purchasers are referred to the relevant agencies for future supplies.

	Agents.
Mil. 3/2	Messrs. Rosehaugh Co., Ltd., Colombo.
Wag. 6278	Messrs. George Steuart & Co., Colombo.

Imported clones (for sale by agreement. The R. R. I. C. is the sole agent for the distribution of this material in Ceylon).

	Price per yard. Rs. cts.
RRIM 501, 513 (Malaya)	7.00
LCB 1320 (Indonesia)	7.00
IRCI 7 & 10 (Indochina)	7.00
OY 1 (available 1955)	7.00

The following clones are free clones and can be supplied without any agreement concerning re-sale of the material.

Clones.	Price per yard.
AVROS 255, 157,* 163* BD 5, BD 10 BR 2 * Glen 1 PB 86, PB 23 * PR 107 Tjir 1, Tjir 16 War. 4 LCB 870 Nab. 12, 15 and 20	Rs. 2.50

* These clones are suitable only as seed parents in seed gardens.

The clones available are not all recommended for large scale planting. Some of the clones as indicated above are recommended exclusively for use as good seed parents in seed gardens for production of high quality clonal seed and are not high yielding in themselves. The Rubber Research Institute should be consulted before a choice of clones is made for large scale planting.

The price of budwood per yard covers the cost of budwood, packing and transport to Kalutara-South Railway Station. Budwood will not be despatched on Saturdays, Sundays or Mondays. A minimum of 10 successful budgrafts per yard of budwood can normally be obtained.

The budwood is carefully cut, packed and labelled before despatch, and if it is kept moist in a cool place, the buds can be used satisfactorily up to 5 days after cutting.

Claims for replacement of budwood stated to be unsatisfactory by the purchaser will not necessarily be entertained and the decision of the R.R.I.C. will be final.

Excess budwood in the R.R.I.C. propagation nursery will be sold at reduced prices when available in lots of 100 yards and over. Supplies of clonal seed are not available from the Rubber Research Institute. Budded stumps cannot normally be supplied except from surplus material after our R.R.I.C. requirements have been satisfied.

LETTER TO A PLANTER

by

D. H. Constable

The letter reproduced herewith by courtesy of the planter concerned is, I hope, self explanatory. As he expressed himself as fully convinced by the reasoning, it appeared worth while to give greater publicity to a point which we believe is the subject of some dispute in the Industry.

" During my recent visit you asked my reactions to the theory that Phosphate is sufficient for full growth of young rubber.

The following figures for girth resulting from various treatments will interest you. (Figures taken in 1953 after 18 months manuring).

	O	P	NP	PK	NPK	
Ambatenne	10.82"	12.00"	12.46"	11.74"	12.82"	4 year old planting with 2 years treatment.
Mirishena	3.93	4.41	4.56	4.39	4.84	
Epping Forest	4.91	5.17	5.36	6.31	6.33	
Hewagam	6.25	6.20	6.92	6.43	6.51	
Degalessa	4.65	4.67	5.25	4.68	5.48	
Ederapolla	5.51	5.79	N.T.	N.T.	6.43	
Kepitigalla	3.81	3.88	4.18	3.83	4.30	
Lochnagar	4.22	4.49	4.57	4.67	4.55	
Dartonfield	24.9	29.0	29.1	29.0	29.7	14 year old planting

You will observe the following: in 9 out of 9 cases NPK has beaten P. The odds against this are 1 to 2^9 *i.e.* 1 to 512. Also that in 7 out of 9 cases with 4 treatment choices NPK has come top. In the case of Hewagam the NPK has been badly attacked by rats, so it is reasonable to say 7 out of 8 cases with 4 choices, the odds against which are 2,700 to 1 if NPK is not better than the other treatments.

Regardless however of these results I would recommend the following lines of thought to any V.A. or superintendent.

(1) I know that plants need N, P, and K.

(2) I do not know anything about soil conditions and I have no proper means of testing them.

(3) I know quite well that if I under manure young trees I shall have the ill effects for life.

(4) Is it worth while risking all the money, hard work, research into better planting material, etc. just to save 10–20 rupees per acre on manure for 5–6 years.

Finally, I would say as follows : the R.R.I. have issued a recommendation based entirely on safety, with the natural concomitant of any insurance, that it is slightly more costly. Anybody who ignores those recommendations on a large scale and without ample evidence is taking a very heavy responsibility on himself."

RUBBER RESEARCH INSTITUTE OF CEYLON

Draft minutes of the 125th meeting of the Rubber Research Board held at the Planters' Association Head Quarters, Colombo, at 2-30 p.m. on Monday, 1st March, 1954.

Present.— Mr. W. P. H. Dias J.P. (in the Chair), Mr. G. H. Dulling, Mr. W. Herbert de Silva, Mr. R. J. Hartley, Major Montague Jayawickrema, M.P., Dr. A. W. R. Joachim, O.B.E. (Director of Agriculture) Gate Muhandiram Arthur D. S. Jayasinghe, Mr. B. Mahadeva, C.C.S. (Rubber Controller), Senator C. F. W. Wickremasinghe, Dr. H. E. Young, Director and Mr. C. D. de Fonseka, Administrative Secretary.

Dr. Bateman, Director of the British Rubber Producers' Research Association, was present by invitation.

1. Board.

Membership of Major Montague Jayawickrema, M.P.— The Chairman reported that all members had agreed that Major Montague Jayawickrema, M.P., whose membership had lapsed owing to non-attendance at three consecutive meetings of the Board, be restored to membership.

2. Minutes.

Confirmation.— Draft minutes of the meeting held on 21st December 1953, which had been circulated to members, were signed by the Chairman.

3. Address by Dr. Bateman.— The Chairman welcomed Dr. L. Bateman, Director of the B.R.P.R.A., who had arrived in Ceylon a few days earlier on his way to the International Meeting of Directors and Chief Executives of Research Units to be held at Bogor, Indonesia, in mid March. Dr. Bateman gave a short account of the history and work done by the B.R.P.R.A. He showed samples of cyclised rubber made by a process developed by the B.R.P.R.A. ; also socks etc. treated with positised latex.

4. Experimental Committee.

Recommendations made at meeting held on 1st February 1954.

(a) Alternative signatory for Estate Department Bank account.— The recommendation that the Administrative Secretary be authorised to sign cheques on the Estate Department bank account in the absence of the Estate Superintendent was approved.

(b) End of Contract leave for Senior Officers.— As recommended by the Committee, it was agreed that the periods of end-of-contract leave of the Chemist, the Estate Superintendent, the Agronomist, the Administrative-Secretary and the Director, whose contracts terminate in 1955, should be staggered so that work may proceed without interruption to research, advisory and development programmes. The period of leave was defined in the case of each officer.

(c) Appointment of two Accounts Clerks.— The recommendation that the two new accounts clerks be appointed one month before the Chief Clerk retires, *i.e.* with effect from 1st April, 1954, was approved and a supplementary vote was passed to cover the cost of their salaries and allowances for April.

5. Training of Estate Superintendents.— Agreed that three young men, the sons of proprietary planters, be given a training in estate work for a period of six months to enable them to look after their family estates after training.

6. Appointment of Plant Pathologist.— After considering the applications received it was decided that the post be re-advertised and that an effort be made at the same time to obtain the services of an experienced officer through the medium of the F.A.O. and the Technical Aid Plan.

7. Rubber Instructors.— Agreed that five additional Rubber Instructors be appointed to the Staff of the Smallholdings Dept. to cover the extra work arising from the operation of the subsidised Rubber Replanting Scheme.

8. International meeting of Directors & Chief Executives of Research Organisations.— An invitation to the Director to attend a meeting of Directors and Chief Executives of Research Organisations at Bogor, Indonesia, from 14th to 20th March, 1954, was considered and it was agreed that he should attend. The Chairman was also authorised to attend if an invitation could be obtained for him.

9. Re-engagement of Chemist.— Agreed that Dr. E. J. Risdon, Chemist, be offered re-engagement for a further period on the termination of his present contract in December, 1954. The terms of re-engagement were considered.

10. Reports and Accounts.

(a) Statement of Receipts and Payments for the Quarter ended 31st December 1953 — was approved.

(b) Sale of planting material.— Prices to be charged for planting material to be sold from the Institute's nurseries were defined.

11. Staff.

(a) Research Assistant (Agronomy Dept.).— A report from the High Commissioner for Australia, on the satisfactory progress of Mr. A. J. Jeevaratnam, Research Assistant, at the Waite Agricultural Institute was read.

(b) Research Assistant (Botany Dept.).— It was reported that Mr. L. B. Chandrasekera had assumed duties as Research Assistant (Botany Dept.) with effect from 2nd January, 1954.

(c) Technical Assistant to the Director.— The appointment of a Techical Assistant to the Director to undertake duties as defined by the Director was approved.

(d) Assistant Staff.— Changes in staff since the last meeting were reported.

12. London Advisory Committee.

(a) Nominations.— The following nominations were reported :

1. Nominated by the Secretary of State for the Colonies — Mr. D. Rhind.
2. Nominated by the High Commissioner for Malaya in place of Mr. J. Lornie who has resigned — Mr. W. C. S. Corry.

(b) Draft minutes of the 59th meeting of the Committee held on 30th October 1953 — were tabled.

13. PUBLICATIONS.— The following publications were tabled.

(a) Leaflet No. S.H.6 — Replanting of rubber smallholdings under the subsidy scheme.

(b) Combined 1st & 2nd Quarterly Circulars for 1953.

Before the meeting terminated the Chairman referred to the impending retirement of Mr. Hartley who had been a member of the Board since 1943. He thanked Mr. Hartley for the invaluable assistance rendered by him in his capacity as a Board member and wished him long life and continued good health in his retirement.

Sgd. C. D. DE FONSEKA,

Administrative Secretary.

Dartonfield,

Agalawatta, 24-3-54.

RUBBER RESEARCH INSTITUTE OF CEYLON

Draft minutes of the 127th meeting of the Rubber Research Board held at the Planters' Association Head Quarters, Colombo, at 2-30 p.m. on Wednesday 28th April, 1954.

Present.— Mr. W. P. H. Dias J.P. (in the Chair), Mr. G. H. Carter, Dr. A. W. R. Joachim (Director of Agriculture), Major Montague Jayawickrema, M.P., Gate Muhandiram Arthur D. S. Jayasinghe, Mr. L. J. de S. Seneviratne (Deputy Secretary to the Treasury), Senator C. F. W. Wickremasinghe, and Mr. C. D. de Fonseka (Administrative Secretary).

Apologies for absence were received from Mr. B. Mahadeva, Rubber Controller and Dr. H. E. Young, Director.

1. MINUTES.

(a) Confirmation.— Draft minutes of the meeting held on 1st March and of the Special meeting held on 7th April 1954, which had been circulated to members, were confirmed subject to two minor amendments.

(b) Matters arising from the minutes.—

1. International meeting of Directors and Chief Executives of Research Organisations.— The Chairman thanked the Board for having sent him to attend these meetings and said that he had taken the opportunity to visit some of the larger rubber estates in Indonesia. He had also made arrangements to obtain budwood of some high yielding clones.

2. Re-engagement of Chemist and terms of service of overseas officers.— A sub-committee consisting of five members of the Board was appointed to consider the terms of re-engagement of the Chemist and certain terms of service applicable to overseas officers.

3. Sale of planting material.— The terms suggested by the Director for distribution of material of the RLD. clones were approved.

2. EXPERIMENTAL COMMITTEE.

Recommendations made at meeting held on 7th April, 1954.—

(a) Membership.— The recommendation that Mr. B. Mahadeva be appointed as an additional member of the Committee was approved.

(b) Visiting Agent's & Visiting Engineer's reports.— were approved.

(c) Annual Report and Balance Sheet for 1953.— These were approved and it was agreed that the Report be published as usual. It was noted that the Balance Sheet had been forwarded to the Auditor General and that his report would be submitted when available. Balances of capital votes amounting to Rs. 234,979/22 were revoted for 1954.

(d) Purchase of Epidiascope.— The recommendation that a Ross epidiascope be purchased at a cost of Rs. 2,600/—was approved and a vote of this amount was passed for the purpose.

The minutes were adopted.

3. STAFF.— Changes in staff since the ast meeting were reported.

A sub-committee consisting of three members of the Board and the S.H.P.O. was appointed to select candidates for appointment to the staff of the smallholdings Dept.

The Smallholdings Propaganda Officer came into the meeting at this stage.

4. SULPHUR DUSTING SMALLHOLDINGS.— Arising from a statement made by a member that the smallholdings in the Kegalle area are badly affected by Oidium, the S.H.P.O. was asked to put up a scheme for sulphur dusting smallholdings in that area during the next Oidium season.

5. EXCHANGE OF CLONES.— Proposed arrangements for the exchange of clones with Indo-China, Malaya and Indonesia were approved.

6. HOLIDAY FOR ROYAL VISIT.— The Chairman reported that 10th April had been declared a holiday for the staff in view of the visit of Her Majesty Queen Elizabeth II.

7. LONDON ADVISORY COMMITTEE.— Minutes of the 3rd meeting of the Agricultural Sub-committee were tabled.

8. RUBBER STUDY GROUP.— In response to a request from the Minister of Commerce, Trade and Fisheries the Chairman and the Director were nominated to attend the meetings of the International Rubber Study Group to be held in Colombo in May, 1954, as advisers to the Ceylon delegation.

The meeting terminated with a vote of thanks to the Planters' Association of Ceylon for the use of its committee room for meetings.

Sgd. C. D. DE FONSEKA,
Administrative Secretary.

Dartonfield,
Agalawatta.
20/5/54.

RUBBER RESEARCH INSTITUTE OF CEYLON

Draft minutes of the 128th meeting of the Rubber Research Board held at the Planters' Association Head Quarters, Colombo, at 2-30 p.m. on Monday, 7th June, 1954.

Present.— Mr. W. P. H. Dias, J.P. (in the Chair), Mr. G. H. Carter, Mr. H. Creighton, Mr. W. Herbert de Silva, Gate Muhandiram Arthur D. S. Jayasinghe, Major Montague Jayewickrema M.P., Dr. A. W. R. Joachim (Director of Agriculture), Mr. B. Mahadeva (Rubber Controller), Mr. L. J. de S. Seneviratne (Deputy Secretary to the Treasury), Dr. H. E. Young (Director), and Mr. C. D. de Fonseka (Administrative Secretary).

1. BOARD.

(a) Change in membership.— The Chairman welcomed Mr. H. Creighton who had been nominated to represent the Planters' Association of Ceylon with effect from 27th April 1954 in place of Mr. G. H. Dulling who had resigned. A vote of thanks was passed for Mr. Dulling's services.

(b) Nomination to Experimental Committee.— On the proposal of the Chairman, Mr. H. Creighton was nominated to serve on the Experimental Committee in place of Mr. G. H. Dulling.

2. MINUTES.

(a) Confirmation.—Draft minutes of the meeting held on 28th April 1954, which had been circulated to members, were signed by the Chairman.

(b) Matters arising from the minutes.—

1. Re-engagement of Chemist.— The recommendations of the Committee which considered the terms of re-engagement of the Chemist were approved with a minor modification regarding emoluments.

2. Research Assistant (Agronomy).—Agreed that Mr. A. Jeevaratnam's scholarship at the Waite Agricultural Institute, Adelaide, Australia, be extended by one year to enable him to complete his M.Sc. Agriculture course.

3. REPORTS AND ACCOUNTS.

(a) Receipts and Payments account for the 1st Quarter 1954.— was approved.

(b) Supplementary Votes.—Supplementary votes amounting to Rs. 16,912/46 were passed.

(c) Planting material for Smallholders.— Agreed that the price of budded stumps to be sold from the Institute's nurseries to new planting permit holders through the Smallholdings Department should be –/75 cts. each.

(d) Tenders for buildings.—Eighteen tenders were considered and contracts awarded to N. H. Karunaratna and H. D. Rampy Singho for the construction of bungalows and cottages respectively.

4. STAFF.

(a) Mycologist.—It was reported that Mr. J. H. Van Emden, Mycologist, had left Ceylon on 17th May. Mr. C. A. de Silva, Botanist, was appointed to act as Mycologist until an appointment is made.

(b) Asst. Mycologist.— Agreed that Mr. D. M. Fernando, Asst. Mycologist, be offered a contract for a further period of four years on the termination of his present contract in October 1954.

5. Integration of Smallholdings Advisory Services for Tea and Rubber.

The Board considered a proposal for the integration of the Smallholdings services of the Tea and Rubber Research Institutes to form a single unit functioning under the control of the Ministry of Agriculture. Members were not in favour of the proposal and it was agreed that the Ministry be informed accordingly.

In this connection, the view was expressed that the headquarters of the Smallholdings Dept. should be transferred from Colombo to Dartonfield and a Sub-committee was appointed to consider the financial implications of the proposed transfer and devise ways and means of improving the organisation of the Smallholdings Department.

6. Final and open meeting of the Chief Executives and Directors of the National Research Units held at Bogor on 16/3/54.— The minutes of this meeting were tabled.

Before the meeting terminated the Chairman congratulated Major Jayewickrema on his appointment as Minister of Transport and Works and thanked him for his valuable services as a member of the Board since March 1949.

Sgd. C. D. de Fonseka,
Administrative Secretary.

Dartonfield,
Agalawatta,
8th July, 1954.

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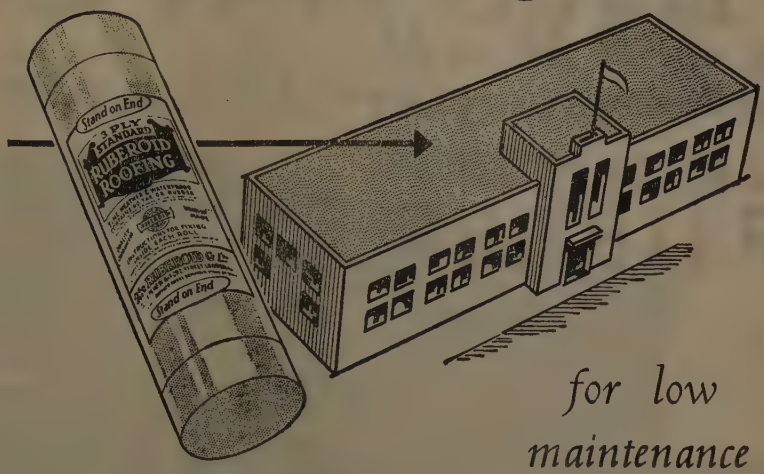

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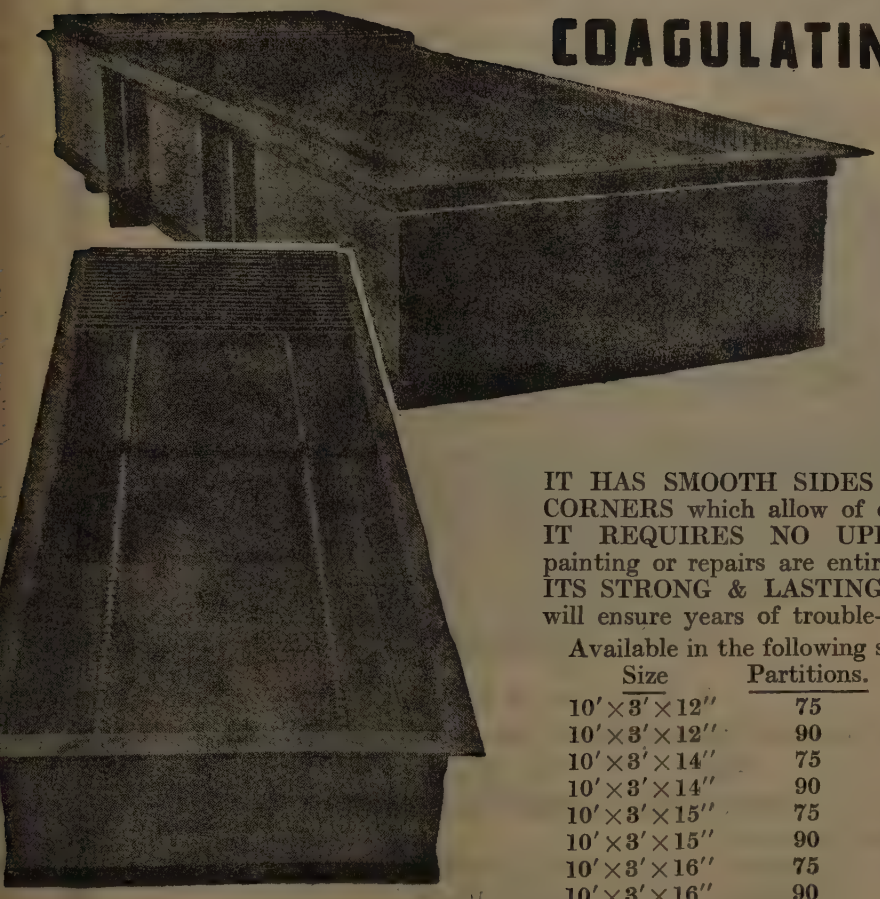

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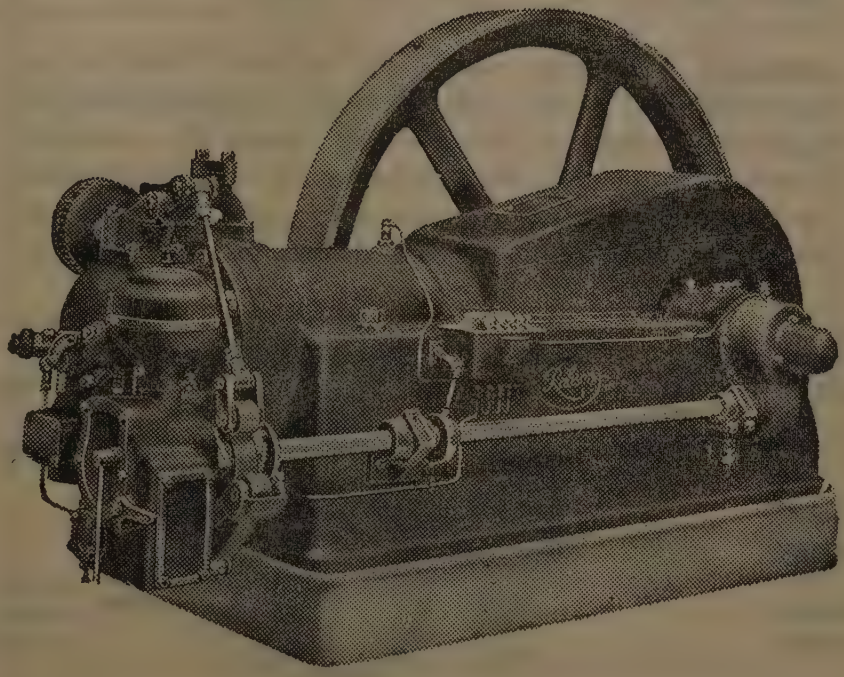

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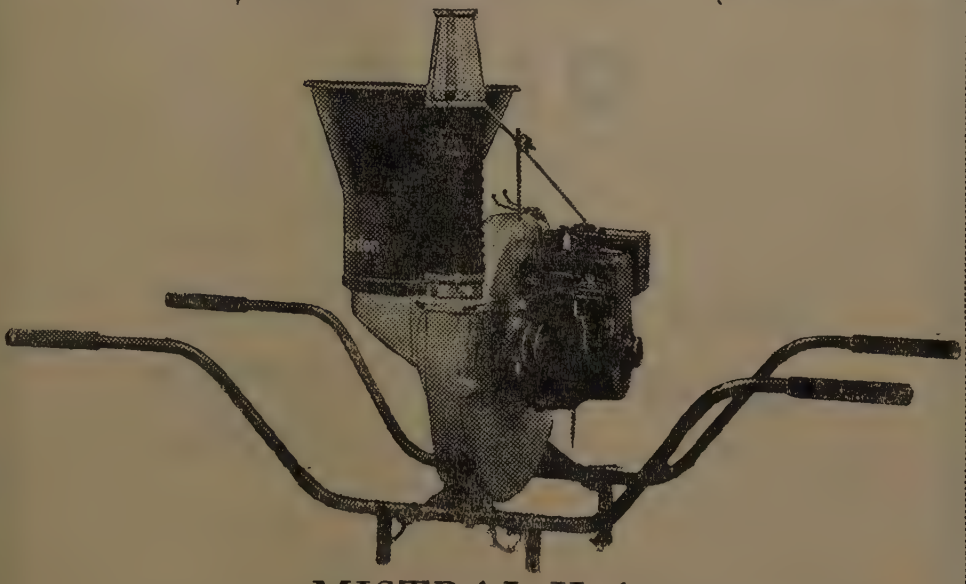

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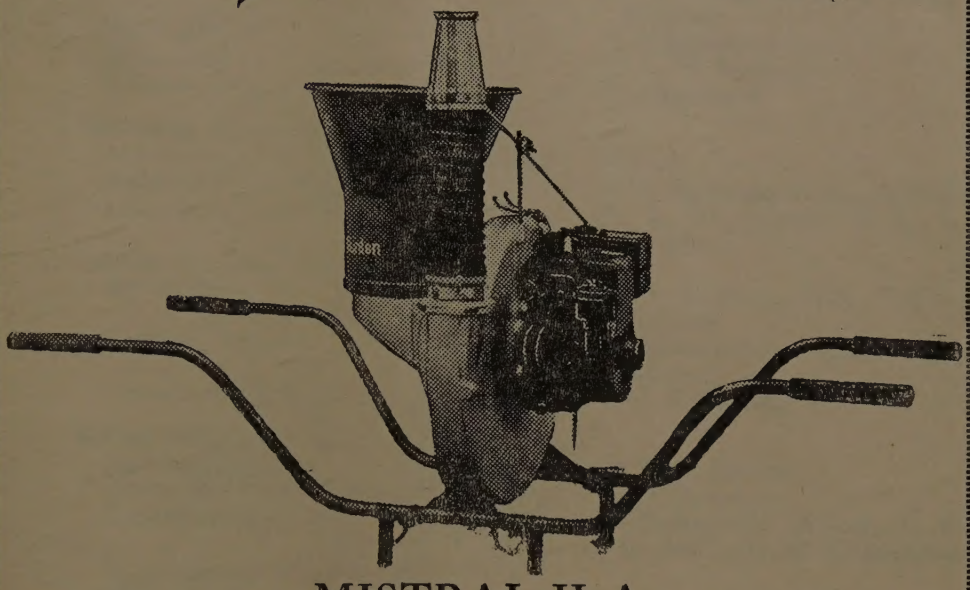

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